



International independent scientific journal

№46 2023



№46 2023
International independent scientific journal

ISSN 3547-2340

Frequency: 12 times a year – every month.
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International independent scientific journal
Kazimierza Wielkiego 34, Kraków, Rzeczpospolita Polska, 30-074
email: info@iis-journal.com
site: <http://www.iis-journal.com>

CONTENT

CULTURAL SCIENCES

Mussina Z., Karimova G., Ospanov G.

THEORY AS PROCESS AND RESULT OF CREATIVE

SEARCH.....3

JURISPRUDENCE

Zhusupov A.

PROBLEMS AND METHODS OF FINANCIAL RESOURCES

REGULATION 7

MATHEMATICAL SCIENCES

Kuralbayev Z.

SOLUTION OF THE BOUNDARY VALUE PROBLEM FOR

A PARTIAL DIFFERENTIAL EQUATION WITH A

NEGATIVE SIGN AT THE HIGHEST DERIVATIVE.....10

MEDICAL SCIENCES

Ibrahimov M., Bayramov G.,

Aliyeva G., Ibrahimova L.

THE ROLE OF BOTH FAMILY DOCTOR AND DENTIST IN

THE EARLY DETECTION OF VESICOVASCULAR

SYNDROME AS A MEASURE FOR THE PREVENTION OF

HYPERTENSION DISEASE15

PEDAGOGICAL SCIENCES

Ibrahimov F.N., Ibrahimova S.F.

INTERPRETATION OF THE "SUBJECT CONTENT BLOCK"

ELEMENTS OF THE TECHNOLOGY SUBJECT

CURRICULUM AT THE GENERAL EDUCATION LEVEL

BASED ON THE "SYSTEM-STRUCTURE" APPROACH ..18

Ilesbekova B.

TEACHERS' PERCEPTIONS OF FORMING

SOCIOCULTURAL COMPETENCE AMONG SECONDARY

SCHOOL STUDENTS IN ENGLISH CLASSES 27

Koryahin V., Hrebinka H., Serbo Ye.,

Tykhiy I., Kozak I., Borovyk Yu.

PEDAGOGICAL AND PHYSIOLOGY ASPECTS OF

CONTENTION ACTIVITY OF SPORTSMEN34

PHYSICAL SCIENCES

Antonov A.

WHY IS THE INCORRECT VERSION OF SPECIAL

RELATIVITY STILL BEING STUDIED IN PHYSICS

TEXTBOOKS, WHICH DENIES OHM'S LAW FOR

ALTERNATING CURRENT USED WORLDWIDE BY

MILLIONS OF RADIO AND ELECTRICAL ENGINEERS? .38

TECHNICAL SCIENCES

Dziatkovskii A.

DIGITALISATION OF EDUCATION BASED ON

BLOCKCHAIN TECHNOLOGY45

CULTURAL SCIENCES

THEORY AS PROCESS AND RESULT OF CREATIVE SEARCH

Mussina Z.,

Turan-Astana university, Kazakhstan

Karimova G.,

Turan-Astana university, Kazakhstan

Ospanov G.

Turan-Astana university, Kazakhstan

ТЕОРИЯ КАК ПРОЦЕСС И РЕЗУЛЬТАТ ТВОРЧЕСКОГО ПОИСКА

Мусина Ж.

Университет «Туран-Астана», Казахстан

Каримова Г.

Университет «Туран-Астана», Казахстан

Оспанов Г.

Университет «Туран-Астана», Казахстан

<https://doi.org/10.5281/zenodo.7525038>

Abstract

The article considers the essence of scientific theory as a process and the result of creative search. Scientific theory is considered as the highest form of organization of knowledge acquisition. Scientific theory in action is an effective, effective method of scientific creativity by increasing a new scientific formation. The method in scientific knowledge is both the method and the reception of the study of creation, and, at the same time, the implementation of the accumulated knowledge, which exists in the form of theory.

Аннотация

В статье рассмотрена сущность научной теории как процесс и результат творческого поиска. Научная теория рассматривается как наивысшая форма организации получения знаний. Научная теория в действии - эффективный, действенный метод научного творчества путём приращения новой научной формации. Метод в научном знании - это и метод, и прием исследования творения, и, одновременно, реализация накопленного знания, которое существует в виде теории.

Keywords: *scientific theory, idealization, creativity, hypothesis, verification, falsification*

Ключевые слова: *научная теория, идеализация, творчество, гипотеза, верификация, фальсификация*

Процесс творческого научного познания, начинаясь на опытно-эмпирическом уровне с добывания, получения научных фактов в ходе опыта, наблюдения или эксперимента, продолжается затем на следующем, более глубоком, теоретическом уровне.

Проверка научных догадок, версий и гипотез при помощи процедур верификации (М.Шлик, Г.Рейхенбах, Р.Карнап, Ф.Франк, А.Тарский и др.) или фальсификации (К.Поппер, Т.Кун, И.Лакатос, П.Фейерабенд, Я. Лаудан и др.) позволяет выбраковывать негодные гипотезы, оставляя наиболее правдоподобные (верифицируемые или, соответственно, фальсифицируемые) из них. Гипотезы, прошедшие тест на соответствие их содержания истинному положению дел, меняют свой статус в структуре теоретического познания: из знания вероятного, они становятся знанием достоверным и обретают статус научного закона или закономерности. Закон - это устойчивое, повторяющееся, необходимое, инвариантное, существенное в структуре явления. Изучение научного закона позволяет глубоко осмыслить и определить сущность и причину изучаемого явления.

Теоретический уровень научных знаний и творчества начинается с комплексного анализа, отражения, интерпретации научной информации, которую научный поиск получил на предыдущем - эмпирическом уровне. На теоретическом уровне вначале творческая мысль исследователя выдвигает более или менее правдоподобные догадки, версии, гипотезы, позволяющие более и более полно понять суть полученных эмпирических знаний. Тогда пытливый разум учёного отвергает версию и гипотезу, которые не удалось проверить, пытается выявить определённые зависимости и узоры между свойствами исследуемого объекта и внутренними и внешними условиями его развития и эволюции. Например, в случае физических исследований такими условиями являются следующие факторы: время, температура, давление, изменение которых напрямую влияет на характер поведения физического объекта. В случае биологических исследований, например, в популяционной генетике, такими условиями могут быть факторы окружающей среды.

Так, наблюдая за жизнью двух популяций животных на протяжении нескольких десятков лет -

рысей и кроликов - в заповеднике на севере Канады, ученые этологи (биологи изучающие поведение и повадки животных) выявили следующую важную и любопытную закономерность: совместное проживание на одной территории популяций «хищников» (рыси) и «жертв» (кролики) привело их к взаимной адаптации и корреляции численности одной из них от численности другой популяции. Кролики размножаются быстро и в геометрической прогрессии, что является положительным внешним условием для размножения рысей - много корма, поэтому численность рысей тоже быстро растет. Численный рост популяции рысей - это неблагоприятный внешний фактор для кроликов и их численность начинает падать, что в конце концов приводит, в свою очередь, к падению численности рысей. Малое количество рысей - очень благоприятное условие для быстрого размножения кроликов, поэтому их популяция стремительно растет и весь цикл сложного взаимодействия по схеме «хищник-жертва» повторяется вновь. Выявление такой закономерности между численностями двух соседствующих популяций позволило замечательному итальянскому математику Вито Вольтерра создать стройную математическую модель такого явления и на основе математического анализа этой модели и N уравнений, описывающих ее, сформулировать математическую теорию борьбы за существование в популяционной генетике.

Результатом теоретического анализа и абстрагирования является формирование объектов данной теории или творческих объектов. Любая теория, основанная на истинном знании, ближе к познанию конкретного в его целостности, чем до теоретические разрозненные знания. Теоретические объекты - это мысленные конструкции, абстракции, в которых отражается объект познания с заведомо определенной степенью приближения. Например, можно решать задачу о колебаниях вполне реального физического тела абстрагируясь от его особенностей и индивидуальных черт, рассматривая это тело как абстрактный «математический маятник».

Эвристическая ценность научных идеализаций, абстракций определяется возможностью основанной на них теории объяснять данные опыта, а также предсказывать существование новых, ранее неизвестных характеристик и свойств объекта.

Эвристическая ценность научных идеализаций, абстракций определяется возможностью основанной на них теории объяснять данные опыта, а также предсказывать существование новых, ранее неизвестных характеристик и свойств объекта.

Теоретическое познание в науке не останавливается на выдвижении и проверке остроумных гипотез и формулировании законов и правил. Вершиной, логическим завершением, итогом научного творчества является создание точной, глубокой и истинной научной теории. Построение научной теории - это сложный, диалектически противоречивый процесс выявления и оперирования глубокими и содержательными научными абстракциями, процесс абстрагирования на теоретическом уровне

научного познания. Примерами таких глубоких и ценных научных абстракций служат «материальная точка» в математике «абсолютно гладкая поверхность», «движение без трения и проскальзывания» в механике, «идеальный газ», «абсолютно черное тело» в физике и др. Научные абстракции обладают глубокой эвристической, творчески-познавательной силой. Научный закон, научная теория опирается на подобные абстрактные объекты, что позволяет им лучше и подробнее объяснять поведение и жизнь реальных систем. Пример продуктивных, содержательных абстракций в экономической теории: товар, меновая и потребительная стоимость, рынок и т.д.

Важной формой теоретического абстрагирования является идеализация - это абстрагирование от таких сторон предмета или условий его существования, без которых он реально не существует. Например, в оптике говорят об идеально отражающих и идеально поглощающих поверхностях, в термодинамике об идеальных газах и т.п. Такие научные идеализации иногда называют введением принципиально неосуществимых условий (например, полное отсутствие инфляции в рыночной экономике).

Любая научная идеализация создается для решения определенной проблемы. Характер идеализации определяется содержанием этой проблемы. Так, создавая специальную теорию относительности, А. Эйнштейн исключил из физической теории такие фундаментальные идеализации классической физики как «абсолютное пространство» и «абсолютное время», что позволило ему сформировать современную релятивистскую научную картину мира. Творчество великого гения привело не только к великому открытию в науке, но и повлияло на изменение всего человеческого мировоззрения, отношение человека к объективной реальности. Отныне понятия движения, пространства, времени были объединены в единое научное понятие о 4-х мерном пространственно-временном континууме, свойства которого определяются поведением физических тел и полей.

Научная теория - основа научного творчества - систематизирует, обобщает и объясняет свойства определенной области реальности и, более того, предсказывает новые, неизвестные эффекты и явления. Систематизация, согласование, подчинение научного материала осуществляется научной теорией. Ядром любой научной теории являются её законы, принципы, исходные предположения и гипотезы. Именно в этом ядре сосредоточен творческий потенциал теории для объяснения и прогнозирования фактов.

Теоретический уровень научного творчества - это неуклонное погружение познающего разума в сущность накопленного знания, уплотнение, насыщение его и повышение практической отдачи.

Наиболее глубокие научные теории, такие, как эволюционная теория Ч.Дарвина, теория высшей нервной деятельности И.П.Павлова, квантовая теория Э.Шредингера, В. Гейзенберга, Н. Бора и мно-

гие другие, будучи результатом творческого мышления титанов современной науки, опираются как на огромный фактический материал, так и на широкие, смелые обобщения и идеи, с помощью которых весь накопленный научный материал подвергается рациональной обработке. Многие эвристические, творческие, плодотворные идеи, лежащие в теоретическом фундаменте современной науки, великий датский физик Нильс Бор остроумно называя «безумными». Он часто говорил своим ученикам: «Ваша идея не достаточно безумна, чтобы быть истинной». Эти высказывания великого современного физика следует понимать в таком смысле, что творческая смелость теоретика должна смело ломать сложившиеся стереотипы научного мышления, отвергать устаревшие теории, вторгаться вглубь изучаемого явления, ощущая его внутреннюю глубину и скрытую парадоксальность.

В истории и эпистемологии науки первый успешный опыт построения глубокой содержательной научной теории дает элементарная геометрия Евклида, построенная на стройной, логически непротиворечивой системе аксиом, т.е. исходных положений, принимаемых в данной теории без доказательств и доказываемых на их основе теорем о свойствах геометрических тел - плоских (планиметрия) и объемных (стереометрия). Далее, используя в своем творчестве аксиоматический метод построения геометрии, многие выдающиеся математики открыли целый класс других, неевклидовых геометрий. Аксиоматические теории находят большое применение в тех областях науки, где используемые понятия обладают значительной стабильностью и можно абстрагироваться от их изменения и развития. Именно в этих условиях становится возможным выявить содержательные и формально-логические связи между различными компонентами теории.

Научной теории, как высшей форме организации получения знания, свойственны противоположные тенденции: системности и элементности. Как интегральная, целостная, динамичная система растущего знания теория в науке дает целостное представление о событиях и предметах внешнего мира, их внутренней структуре и закономерностях бытия. Теория выявляет причинную зависимость между фактами, формулирует научные законы и вскрывает реальные закономерности. Научная революция происходит тогда, когда на смену имеющихся научных теорий, парадигм (Томас Кун) исследовательских программ (Имре Лакатос) приходят новые более содержательные, глубокие, информативно насыщенные идеи и теории.

Различаясь по форме, научные знания (факты), теория и метод совпадают в содержании - они имеют целью отразить объект таким, каков он на самом деле реально есть. В современной науке объект исследования рассматривается в развитии, с различных сторон, со всеми его связями и отношениями. Поэтому, подход к объекту носит системный, комплексный характер, следовательно, только система методов, теорий, законов, гипотез в состоянии характеризовать объект познания полностью.

Научная теория является наиболее развитой, совершенной, зрелой формой познания. Она наиболее полно и глубоко отражает реальность. Это строгая, логически последовательная система знаний, в которой на данный момент достигается высшая степень правдивости знания. Развитие научной теории, семи теорий и парадигм, тесно связаны с социальной практикой, обусловлены наличием или отсутствием в обществе социального порядка для того или иного теоретического знания.

Научная теория, как активный, постоянно работающий и обогащающий элемент научного творчества, является системой объяснения в науке. В нем обобщаются накопленные факты и знания, выявляются объективные узоры, выявляются тенденции от изменения объекта и предвидится будущее.

Цель теоретических исследований - установление связей между существующими экспериментальными данными, более глубокое понимание сущности и структуры бытия, открытие новых перспектив, о директивах и путях научного творчества.

Основными элементами всякой содержательной научной теории является:

- эмпирико-теоретическая основа;
- логический и категориальный аппарат;
- выводимые следствия и заключения.

Полнота, глубина, истинность научной теории проверяется функциями, которые она выполняет в научных исследованиях: объяснять и предсказывать. Поясняя, теория относится к прошлому, к уже имеющимся фактическим знаниям. Предрасполагая, теория обращается в будущее, выполняя роль научного предсказания и предвидения, экстраполируя имеющиеся знания во власть неизведанных и до сих пор неизвестных.

Систематизация - важнейший, необходимый этап построения научной теории. На этом этапе происходит первичная, грубая обработка фактов на основе рабочих предположений, версий и гипотез, когда происходит сортировка, отторжение, отбор существующих фактических знаний и предпринимается первая, часто робкая, неверная попытка выстроить существующие факты в более или менее стройную логическую структуру. В дальнейшем эта первичная структура по мере созревания теории будет постоянно корректироваться, уточняться, трансформироваться и, даже, может не войти в окончательный вариант теории.

Важной стороной систематизации знания в строящейся теории является описание - исходный материал для объяснения. Описательный метод находит частое применение в таких науках, как педагогика, психология, биология, геология, география, социология, криминалистика, языкознание.

Следующий этап - объяснение, то есть раскрытие связей между фактами, законами, изложение обобщающих идей, вскрытие внутренних и внешних причин существования и изменения объектов теории. При объяснении фактов логически вывожу законы науки из основных положений теории (её аксиом, основами буквальными идей и т. д.). Часто объяснение считается основной функцией теории,

её эвристической сущностью. Систематизация знания и его объяснение позволяют регулировать, направлять и контролировать процесс научного творчества. Имея теорию, можно заранее сказать, какие эмпирические данные следует найти и при каких условиях их можно обнаружить.

За этим следует расширение, углубление и уточнение научных знаний. Построение научной теории не сводится к простому сочетанию динамики существующего знания, а имеет предполагаемую возможность логического вывода на основе существующей теории знания, которая была известна до его построения, то - получение новых, ранее неизвестных знаний и, таким образом, расширение границ непризнанного и, наконец, углубление и исчерпание существующих представлений об изучаемой области реальности.

Руководящая роль, подлинно творческая созидательная ценность научной теории заключена в возможности предсказания новых фактов, когда на основе теории строится достоверный, строго выверенный научный прогноз. Многие ранее не наблюдавшиеся в природе явления были сначала предсказаны теорией, а лишь затем обнаружены опытным путем. Например, общая теория относительности А. Эйнштейна предсказала эффект отклонения траектории распространения лучей света вблизи массивных тел, скажем звезд, а затем астрофизики своими наблюдениями подтвердили это замечательное предсказание. Электродинамика Д.К.Максвелла предсказала существование электромагнитных волн, а затем Г.Герц обнаружил их экспериментально. На основе своей периодической системы элементов Д.И. Менделеев предсказал существование ряда неизвестных химических элементов, дальнейшее развитие химии блестяще подтвердило это предсказание. Г.Н.Волков предсказал и обосновал функционирование науки этнопедагогика, ученые-педагоги разных государств подтвердили и развили эту науку, внося национальные традиции, обычаи, фольклор и т.д. Число подобных примеров можно увеличить. Все они свидетельствуют о том, что предсказание, предвидение новых, неизвестных явлений - важная функция научных теорий.

Теоретическое знание в науке носит синтетический, комплексный характер.

Теория это не простая совокупность, арифметическая сумма эмпирических и теоретических знаний, а их

глубокий синтез, интегральное целое из фактов, событий, гипотез, законов и фундаментальных положений, лежащих в основании данной теории: аксиом, исходных предположений и допущений и т.д. Таким образом, своей синтезирующей ролью зрелая научная теория покрывает как теоретический, так и эмпирический уровни научного творчества.

Выход на практику имеет важную эвристическую роль как для самой теории, так как именно практика выступает в конечном счете тем критерием истинности, который подтверждает или опровергает правильность и глубину теории, так и для самой практики, которая, опираясь на теоретические знания и выводы видоизменяет и улучшает человеческую жизнь. Основатель Копенгагенской школы квантовой механики, выдающийся физик Нильс Бор пророчески сказал: «Нет ничего практичнее хорошей теории». Этот вывод гениального ученого находит подтверждение и в развитии науки и в повседневной жизнедеятельности человека.

Научное творчество - одна из сложнейших и увлекательнейших, интереснейших областей человеческой жизни. Поиск фактов, их теоретическое объяснение, выдвижение гипотез, теорий, формулирование научных законов и логических следствий из них - в этом суть научного творчества, а его результат - приближение человеческого познания к объективной истине.

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JURISPRUDENCE

PROBLEMS AND METHODS OF FINANCIAL RESOURCES REGULATION

Zhusupov A.

"ESIL UNIVERSITY"

Astana, Republic of Kazakhstan

ПРОБЛЕМЫ И МЕТОДЫ РЕГУЛИРОВАНИЯ ФИНАНСОВЫМИ РЕСУРСАМИ

Жусупов А.

"ESIL UNIVERSITY"

Астана, Республика Казахстан

<https://doi.org/10.5281/zenodo.7525086>

Abstract

The article describes the specifics and method of financial law in a combination of methods of legal regulation, defined by the main directions and principles of state financial policy, as well as the essential features of financial resources.

Аннотация

В статье описана специфика и метод финансового права в сочетании способов правового регулирования, определенный основными направлениями и принципами государственной финансовой политики, а так же определены существенные признаки финансовых ресурсов.

Keywords: *finance, financial resources, finance, finance of the state, fiscal and legal policy, budgetary, intergovernmental relationship.*

Ключевые слова: *финансы, финансовые ресурсы, финансовое право, финансы государства, бюджетно-правовая политика, бюджетные, межбюджетные правоотношения.*

Регулирование и управление государственными финансами было основной деятельностью любого государства в любой исторический период. Ведь государство не может существовать без финансов, которые определяют сам политический рост и историческую динамику государства. Многие политические перемены и потрясения в общественной жизни произошли из-за финансового хаоса. Возможно, политическая карта каждого государства была бы другой, если бы не финансовый кризис. Особенности методов финансового права обусловлены прежде всего особенностями предмета правового регулирования в данной области права. Правовые нормы о сборе, распределении и использовании государственных средств основываются на методах, применяемых исключительно для данной категории правоотношений.

Финансы являются без исключения первоисточником информации обо всех процессах общественной жизни и государства, служат орудием формирования и функционирования систем прямого и обратного действия во всех областях народной жизни и общества. Основными средствами реализации направлений национальной политики, как правило, являются правовые механизмы и методы. Проведение денежно-кредитной политики подпадает под нормы финансового права и поэтому подчиняется финансово-правовым методам. Учитывая тесную и неразрывную связь методов финансового права с социально-экономическими процессами, происходящими в обществе, одной из существенных характеристик методов финансового права и

юридического права является национальная денежная политика зависит от. Полагаем, что национальная фискальная политика определяет цели и задачи решений, направленных на то, что бы процессы формирования, распределения и перераспределения общественного богатства обеспечивал и финансовые ресурсы для осуществляемого воспроизводственного процесса. Репродуктивные индивидуальные потребности. Сильная зависимость финансового права от политики обусловлена, прежде всего, тем, что на принятие финансово-правовых норм, а значит, и на финансово-правовые действия оказывают влияние различные политические силы. Это выражается в том, что наиболее широкое внедрение траектория политического процесса; во-вторых, тот факт, что принятие финансово-правовых норм чаще всего происходит в условиях политических процессов, приводящих к конфликтам между различными политическими силами. Соотношение между политической целесообразностью и юридической необходимостью в практике финансовой деятельности и указывает на важную конструктивную роль бюджетных отношений как части предмета финансового права. В связи с этим, по мнению авторов, представляется возможным отвести фискальной и правовой политике ведущую роль в механизмах финансово-правового регулирования. Благодаря тесной взаимосвязи права, политики и экономики бюджетно-правовая политика придает динамику, воплощает, направляет и определяет пути совершенствования механизмов финансового и правового регулирования.

На современном этапе развития Республики Казахстан фискальная политика направлена на достижение экономического баланса между удовлетворением потребностей государства и повышением общего уровня общественного благосостояния. В связи с этим проводятся реформы налоговой системы, с одной стороны, усилены меры по отношению к неплательщикам и повышен уровень собираемости налогов. Сроку платы налогов и предоставления различных налоговых льгот. В сфере бюджетной политики наметилась тенденция к более четкому разграничению доходных и расходных полномочий между уровнями бюджетной системы с целью централизации бюджетной системы и усиления контроля за расходованием бюджетных средств в стране. Система обслуживания казначейских счетов.

Аналогичным образом можно охарактеризовать политику финансового контроля за проведением валютно-обменных операций финансовым юридическим персоналом. Поскольку метод финансового права предназначен для регулирования отношений в сфере национальной финансовой деятельности, используемые им методы в той или иной мере должны отражать сложившиеся тенденции национальной денежно-кредитной политики. Гибкость этого метода обусловлена детализацией сферы действия правовых норм. Государственная финансовая деятельность имеет многообразные формы и является достаточно подвижной и изменчивой сферой общественных отношений, что, безусловно, влияет на ее правовое регулирование.

На наш взгляд, отличительной чертой финансово-правовых методов является их тесная связь с национальной макроэкономической политикой. Наличие прямой зависимости между методом налогово-правового регулирования и основным направлением государственной налогово-бюджетной политики, а также различными законодательными правовыми методами принципиально отличает этот метод от родственных отраслевых методов, особенно административно-правовых.

Учитывая, что финансовое право регулирует финансовую деятельность государственных и местных образований, что является одним из основных публично-правовых интересов, существенным признаком метода правового регулирования является его преобладающий мандат. Высокомерный характер директив, издаваемых органами государственной власти (местными органами власти), позволяет осуществлять контроль над финансами и обеспечивает социально-экономические интересы общества в целом и отдельных лиц в частности. Согласно постановлениям правительства, субъект финансовых правоотношений соответствует системе государственных требований о необходимости эффективного осуществления функций по сбору, распределению и использованию государственных средств. Отказ от выполнения финансово-правовых обязательств, возложенных на субъекта, (уплата налогов, погашение кредитов, перечисление страховых взносов, целевое использование бюджетных

средств и др.), влечет за собой негативные последствия в виде принудительных действий государства, сопровождающихся результатами. Полномочия как неотъемлемая черта методов финансового права не тождественны сущности методов административного права.

Следует отметить, что финансово-правовые методы снижают жесткость властно-подчиненных отношений между субъектами по сравнению с административно-правовыми методами. Предметная подчиненность финансовых отношений развивается в сфере сбора, распределения и использования государственных средств и возникает только в рамках гибких и функциональных правоотношений. Гибкость властной подчиненности проявляется в том, что в сложных финансовых правоотношениях (бюджетных, межбюджетных и др.) одна и та же группа участников может одновременно занимать как доминирующее, так и подчиненное положение. Особенность таких правоотношений обусловлена тем, что финансовая деятельность государственных и местных органов по сбору, распределению и использованию государственных средств осуществляется через многоуровневую финансовую систему государства. Различных финансово-правовых отношений между органами государственной власти и органами местного самоуправления.

Правовые и нормативные методы определения границ осуществления полномочий финансово-зависимыми субъектами требуют определенной степени самостоятельности субъектов в выборе форм и вариантов осуществления возложенных на них финансово-правовых обязательств. В то же время «свобода усмотрения», обеспечиваемая методом денежного права при осуществлении власти, является требованием государственной фискальной политики, направленной на реализацию принципов сбалансированного и эффективного управления государственными финансовыми ресурсами. При этом, в отличие от других методов правового регулирования, применяемых в публично-правовой сфере, методы финансового права предназначены для передачи части полномочий государственных органов (органов местного самоуправления) негосударственным организациям, а в ряде случаев, физические лица.

Такие либеральные тенденции в развитии методов финансового права объясняются общей направленностью государственной денежно-кредитной политики. Сочетание контролируемых государством вмешательств в функционирование финансовой системы и элемента саморегулирования отдельных сегментов позволяет более эффективно контролировать выполнение финансовых и юридических обязательств подчиненными субъектами, в результате чего усиливается контроль между подчиненными сущности. Механизм взаимодействия также значительно упрощен. Субъекты и представители финансовых служб. В рамках налоговых, валютных, валютных и иных отношений допускается передача некоторых полномочий и финансовых полномочий неправительственным организациям лицам.

Появление демократических принципов в государственном управлении явилось предпосылкой использования активных методов правового регулирования в финансово-правовой сфере. Направление власти и собственности в финансовых делах, законодатели используют методы поощрения инициативы субъектов в поиске оптимальных путей решения возникающих проблем.

Управления государственными финансами, требующий взвешенного подхода, научного обоснования и практической проверки. В связи с этим особое значение приобретает вопрос о содержании и структуре метода правового регулирования финансовых отношений. Признавая современные тенденции развития национальной денежно-кредитной политики, методы финансового права меняются в поисках модели правового регулирования, соответствующей новым общественным отношениям. Переход финансовой системы из переходной в стабильную, безусловно, повлияет на содержание инструментов финансового права, а также будет способствовать появлению новых правовых инструментов, дополняющих палитру финансово-правовых норм.

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MATHEMATICAL SCIENCES

UDC 517.946+681.3

SOLUTION OF THE BOUNDARY VALUE PROBLEM FOR A PARTIAL DIFFERENTIAL EQUATION WITH A NEGATIVE SIGN AT THE HIGHEST DERIVATIVE

Kuralbayev Z.*Professor, Doctor of Physical and Mathematical Sciences
Almaty University of Power Engineering and Communications, Kazakhstan, Almaty*

УДК 517.946+681.3

РЕШЕНИЕ КРАЕВОЙ ЗАДАЧИ ДЛЯ ДИФФЕРЕНЦИАЛЬНОГО УРАВНЕНИЯ В ЧАСТНЫХ ПРОИЗВОДНЫХ С ОТРИЦАТЕЛЬНЫМ ЗНАКОМ ПРИ СТАРШЕЙ ПРОИЗВОДНОЙ

Кураббаев З.*профессор, доктор физико-математических наук
Алматинский университет энергетики и связи, Казахстан, Алматы
<https://doi.org/10.5281/zenodo.7525575>*

Abstract

The article considers the solution of a boundary value problem for a second-order partial differential equation with a negative sign at the highest derivative. This equation is obtained as a result of mathematical modeling of creeping movements in a two-layer viscous liquid, when the density of the lower layer is less than the density of the upper layer, and is bounded on both sides by "walls". It is known that due to the difference in the densities of the layers, there is a violation of the equilibrium state of the boundary between them; the materials of the lower layer rise up, and the materials of the upper layer - down. The mathematical description of these movements led to the definition of the law of boundary change between layers. Here there was a need to solve a differential equation, the form of which differs from the usual parabolic equation in that the sign for the highest derivative is negative. Such a difference from a well-studied parabolic equation leads to the need to study the solution of the problem for such a partial differential equation.

Аннотация

В статье рассматривается решение краевой задачи для дифференциального уравнения в частных производных второго порядка с отрицательным знаком при старшей производной. Данное уравнение получено в результате математического моделирования ползущих движений в двухслойной вязкой жидкости, когда плотность нижнего слоя меньше, чем плотность верхнего слоя, и ограниченного с двух сторон «стенками». Известно, что из-за разности плотностей слоев возникает нарушение равновесного состояния границы между ними; материалы нижнего слоя поднимаются вверх, а материалы верхнего слоя – вниз. Математическое описание этих движений привело к определению закона изменения границы между слоями. Здесь возникла потребность решения дифференциального уравнения, вид которого отличается от обычного уравнения параболического типа тем, что знак при старшей производной является отрицательным. Подобное отличие от хорошо исследованного уравнения параболического типа, приводит к необходимости исследования решения задачи для такого дифференциального уравнения в частных производных.

Keywords: partial differential equations with a negative sign at the highest derivative, hydrodynamic instability, motion in a two-layer fluid, general solution of the equation, boundary value problem.

Ключевые слова: дифференциальные уравнения в частных производных с отрицательным знаком при старшей производной, гидродинамическая неустойчивость, движения в двухслойной жидкости, общее решение уравнения, краевая задача.

Постановка проблемы. Многочисленные исследования природных процессов [1-7], происходящих в земных недрах, начатые активно с середины двадцатого века и продолжающиеся в настоящее время, показали актуальность и эффективность применения методов математического моделирования для их изучения. Одной из важных задач в этих исследованиях была связана с изучением тектонических движений из-за различия физических свойств, в частности, различия плотностей верхних слоев Земли. Различия физических свойств земных

слоев является одним из источников происходящих тектонических процессов, изучение которых является актуальной проблемой [1-7]. Модельное исследование в лабораторных условиях впервые было проведено [5] с применением центрифуги.

В результате математического моделирования процессов, происходящих на границе «ползущих» слоев с различными плотностями, были получены различные задачи уравнений математической фи-

зики [8-12]. Актуальность исследования этих процессов связана с изучением причин образования земных структур и их последствий.

Для модельного исследования таких процессов в работах [8,9] была использована модель двухслойной вязкой жидкости. Изменение границы этих слоев стало причиной возникновения различных земных структур, в частности, в земной коре [1-3]. Многочисленные исследования, связанные с определением физических свойств материалов верхних слоев Земли [4-6], привели к использованию модели ползущих движений сильновязких жидкостей.

Постановка математической задачи. Для определения границы между этими двумя слоями было предложено дифференциальное уравнение следующего вида [8,9]:

$$\frac{\partial \xi}{\partial t} = -\frac{\partial^2 \xi}{\partial x^2}, \quad (1)$$

где x – горизонтальная координата, t – время, $\xi = \xi(x, t)$ – искомая функция, которая определяет изменение границы между слоями. Все величины в уравнении (1) являются безразмерными.

Следует заметить, что данное дифференциальное уравнение (1) отличается от известного уравнения параболического типа знаком при старшей производной искомой функции.

Предполагается, что решение данного уравнения (1) ищется в некоторой ограниченной области $x \in (-a, +a)$. Значения искомой функции $\xi = \xi(x, t)$ и ее график считаются симметричными относительно оси ординат и в начале координат ($x = 0$) она достигает своего максимального значения. Считается, что процесс изменения границы между слоями происходит после появления некоторого нарушения ее равновесного состояния с малой амплитудой, и под воздействием разности плотностей материалы более плотного верхнего слоя опускаются вниз, а материалы менее плотного нижнего слоя поднимаются вверх. Поэтому, не ограничивая общность постановки задачи, можно предположить, что в определенный момент времени, т.е. для $t = 0$, может быть задан вид искомой функции.

Решение математической задачи. Здесь предполагается общее аналитическое решение уравнения (1) в следующем виде:

$$\xi(x, t) = u(t) \cdot e^{-x^2 \cdot \varphi(t)} \cdot [1 - 2 \cdot x^2 \cdot \varphi(t)], \quad (2)$$

где $\varphi(t), u(t)$ – неизвестные функции, причем $\varphi(t) > 0$.

Общий вид графика данной функции будет иметь следующий вид:

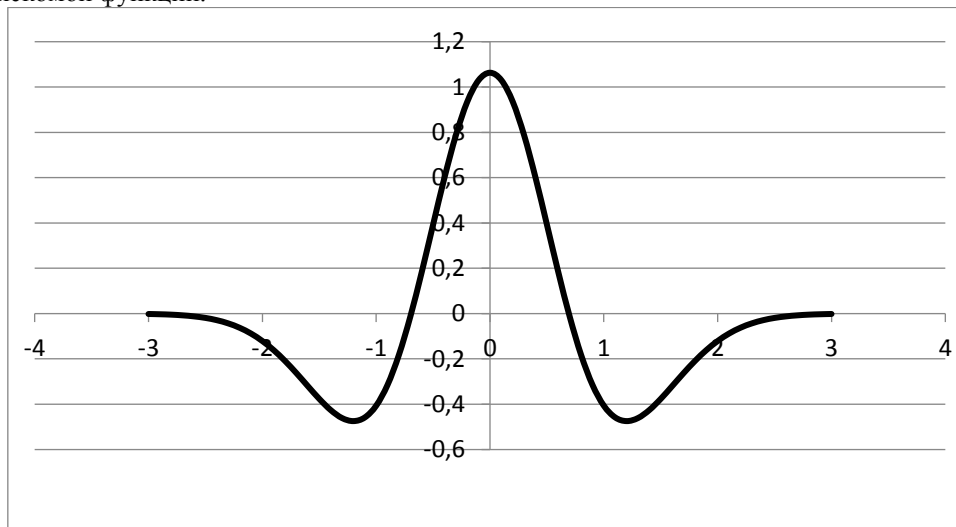


Рисунок 1 – Общий вид функции $\xi(x, t)$.

В данном рисунке 1 по горизонтальной оси расположены значения переменной x , а по вертикали значения функции $\xi(x, t)$.

Исходя из сделанных предположений, могут быть заданы начальные и граничные условия для решения дифференциального уравнения (1). В момент времени $t = 0$ положение искомой функции задано в следующем виде:

$$\xi(x, 0) = u(0) \cdot e^{-x^2 \cdot \varphi(0)} \cdot [1 - 2 \cdot x^2 \cdot \varphi(0)]. \quad (3)$$

На границах при $x = a$ и $x = -a$ искомая функция имеет одинаковые значения из-за предположения о симметрии:

$$\xi(a, t) = \xi(-a, t) = v(t). \quad (4)$$

Здесь функция $v(t)$, которая описывает изменение значения искомой функции на границах, считается неизвестной; она должна быть определена в результате решения поставленной задачи.

Производные искомой функции $\xi = \xi(x, t)$, могут быть определены в следующем виде:

$$\frac{\partial \xi}{\partial t} = e^{-x^2 \cdot \varphi(t)} \cdot \left\{ \frac{du}{dt} \cdot [1 - 2 \cdot x^2 \cdot \varphi(t)] - u(t) \cdot [3 \cdot x^2 - 2 \cdot x^4 \cdot \varphi(t)] \cdot \frac{d\varphi}{dt} \right\};$$

$$\frac{\partial \xi}{\partial x} = e^{-x^2 \cdot \varphi(t)} \cdot u(t) \cdot [-6 \cdot x \cdot \varphi(t) + 4 \cdot x^3 \cdot \varphi^2(t)];$$

$$\frac{\partial^2 \xi}{\partial x^2} = e^{-x^2 \cdot \varphi(t)} \cdot u(t) \cdot [-6 \cdot \varphi(t) + 24 \cdot x^2 \cdot \varphi^2(t) - 8 \cdot x^4 \cdot \varphi^3(t)].$$

Подставляя эти выражения для производных искомой функции в исходное уравнение (1), и после простых преобразований можно получить следующую систему уравнений относительно неизвестных функций:

$$\frac{du}{dt} = 6 \cdot \varphi(t) \cdot u(t); \quad (5)$$

$$\frac{d\varphi}{dt} = 4 \cdot \varphi^2(t). \quad (6)$$

Общие решения этих уравнений записываются в виде следующих формул:

$$\varphi(t) = (C - 4 \cdot t)^{-1}; \quad (7)$$

$$u(t) = A \cdot (C - 4 \cdot t)^{-\frac{3}{2}}. \quad (8)$$

В этих формулах A и C — постоянные интегрирования, значения которых должны быть определены из условий задачи; из условия $\varphi(t) > 0$ следует, что $C > 4 \cdot t$.

Тогда общее решение заданного уравнения (1) записывается в следующем виде:

$$\xi(x, t) = A \cdot (C - 4 \cdot t)^{-\frac{3}{2}} \cdot e^{-x^2 \cdot (C - 4 \cdot t)^{-1}} \cdot [1 - 2 \cdot x^2 \cdot (C - 4 \cdot t)^{-1}]. \quad (9)$$

На границах при $x = a$ и $x = -a$ значение этой функции определено формулой

$$\xi(a, t) = A \cdot (C - 4 \cdot t)^{-\frac{3}{2}} \cdot e^{-a^2 \cdot (C - 4 \cdot t)^{-1}} \cdot [1 - 2 \cdot a^2 \cdot (C - 4 \cdot t)^{-1}]. \quad (10)$$

Теперь о начальном условии. Допустим, что рассматриваемый физический процесс в течение всего рассматриваемого периода времени происходит по закону, описываемому приведенной выше формулой (9). Поэтому для любого момента времени t , в частности, для $t = 0$ она также считается справедливой. Можно предположить, что при $t = 0$ начальное значение функции (9) такое, что неизвестная величина $A = 1$. (Можно предположить, что любое другое значение не влияет на характер изменения значений функции.) Поэтому в дальнейшем будет исследована следующая функция:

$$\xi(x, t) = (C - 4 \cdot t)^{-\frac{3}{2}} \cdot e^{-x^2 \cdot (C - 4 \cdot t)^{-1}} \cdot [1 - 2 \cdot x^2 \cdot (C - 4 \cdot t)^{-1}].$$

Максимальное значение данной функции достигается в одной точке, при $x_0 = 0$:

$$\xi_{max}(0, t) = (C - 4 \cdot t)^{-\frac{3}{2}}. \quad (11)$$

Отсюда следует, что с течением времени t максимальное значение функции $\xi(x, t)$ увеличивается.

Если предположить, что в начальный момент времени ($t = 0$) максимальное значение функции равно $\xi_{max}(0) = \xi(0, 0) = 1$, то $C = 1$. Тогда максимальное значение функции при $x = 0$ равняется

$$\xi_{max}(0, t) = u(t) = (1 - 4 \cdot t)^{-\frac{3}{2}}, \quad (12)$$

а минимальное ее значение определяется в следующем виде

$$\xi_{min}(x_1, t) = \xi_{min}(x_2, t) = -2 \cdot (1 - 4 \cdot t)^{-\frac{3}{2}} \cdot \exp(-1.5). \quad (13)$$

Минимальное значение функции достигается в следующих двух точках:

$$x_1 = \sqrt{\frac{3(1-4 \cdot t)}{2}} \text{ и } x_2 = -\sqrt{\frac{3(1-4 \cdot t)}{2}}. \quad (14)$$

Отсюда следует, что точки минимума (12) функции $\xi(x, t)$ будут подвижными, и зависят от времени t .

Значение функции на границах при $x = a$ и $x = -a$, с учетом сделанных предположений, имеет следующий вид:

$$\xi(a, t) = v(t) = (1 - 4 \cdot t)^{-\frac{3}{2}} \cdot e^{-a^2 \cdot (1 - 4 \cdot t)^{-1}} \cdot [1 - 2 \cdot a^2 \cdot (1 - 4 \cdot t)^{-1}],$$

что означает

$$v(t) = u(t) \cdot e^{-a^2 \cdot (1 - 4 \cdot t)^{-1}} \cdot [1 - 2 \cdot a^2 \cdot (1 - 4 \cdot t)^{-1}]. \quad (15)$$

Рассматриваемый процесс происходит таким образом, что рассматриваемая функция $\xi(x, t)$ имеет положительный и отрицательный знаки в различных областях ее определения. Эти области разделены следующими точками, координаты которых определены в следующем виде:

$$x_3 = \sqrt{\frac{1-4 \cdot t}{2}} \text{ и } x_4 = -\sqrt{\frac{1-4 \cdot t}{2}}. \quad (16)$$

Численные результаты исследования. Теперь, используя полученные формулы (12) – (16), характеризующие рассматриваемый процесс, могут быть вычислены их значения; которые приведены в следующей таблице 1.

Таблица 1.

Значения показателей рассматриваемого процесса

t , время	x_3 , точка минимума функции	x_1 , точка нуля функции	$\xi_{max}(0, t)$, максимум функции	$\xi_{min}(x_1, t)$, минимум функции
0.00	0.7071	1.2247	1.0000	- 0.4463
0.01	0.6928	1.2000	1.1303	- 0.5044
0.02	0.6782	1.1747	1.2842	- 0.5731
0.03	0.6633	1.1489	1.4674	- 0.6548
0.04	0.6481	1.1225	1.6872	- 0.7529
0.05	0.6325	1.0954	1.9531	- 0.8716
0.06	0.6164	1.0677	2.2780	- 1.0166
0.07	0.6000	1.0392	2.6792	- 1.1956
0.08	0.5831	1.0100	3.1610	- 1.4193
0.09	0.5657	0.9798	3.8147	- 1.7023
0.10	0.5477	0.9487	4.6296	- 2.0660
0.11	0.5292	0.9165	5.6942	- 2.5411
0.12	0.5099	0.8832	7.1120	- 3.1738
0.13	0.4899	0.8485	9.0422	- 4.0352
0.14	0.4690	0.8124	11.7393	- 5.2388
0.15	0.4472	0.7746	15.6250	- 6.9728
0.16	0.4243	0.7348	21.4335	- 9.5649

Пусть теперь рассматривается оценка «площадей» поднимающихся веществ нижнего и опускающихся веществ верхнего слоя. Границы их определены точками, где функция, определяющая их границу имеет значение, равное нулю, т.е. $\xi(x, t) = 0$. Из-за симметрии можно ограничиваться только правой частью области определения функции, т.е. $0 \leq x \leq a$. Здесь рассматриваются две участки, соответствующие следующим промежуткам: $0 \leq x \leq x_3$ и $x_3 \leq x \leq a$. Для анализа оценки площади «положительной» части рассматриваемой области $0 \leq x \leq x_3$ используется следующий интеграл:

$$J_1(t) = \int_0^{\sqrt{\frac{1-4t}{2}}} \xi(x, t) \cdot dx = [\sqrt{2 \cdot e} \cdot (1 - 4 \cdot t)]^{-1}. \quad (14)$$

Для «отрицательной» части оценка площади имеет вид:

$$J_2(t) = \int_{\sqrt{\frac{1-4t}{2}}}^a \xi(x, t) \cdot dx = a \cdot e^{-a^2 \cdot (1-4t)^{-1}} - J_1(t). \quad (15)$$

Здесь постоянная $\sqrt{2 \cdot e}$ величина имеет значение

$$\sqrt{2 \cdot e} = 2.331643981597124, \quad \text{так как } e = 2.718281828459045.$$

Вычисления проводились для двух случаев, когда рассматриваемая область $-a \leq x \leq a$ имеет различную длину. Ниже, в таблицах 2 и 3 приведены результаты вычислений по вышеприведенным формулам.

Таблица 2.

Значения интегралов (14) и (15) для $a = 1$

t	$J_1(t)$	$J_2(t)$	$k = J_1(t):J_2(t)$
0.00	2.3316	- 1.9638	- 1.1873
0.01	2.4288	- 2.0759	- 1.1700
0.02	2.5344	- 2.1972	- 1.1535
0.03	2.6496	- 2.3286	- 1.1378
0.04	2.7758	- 2.4717	- 1.1230
0.05	2.9146	- 2.6281	- 1.1090
0.06	3.0680	- 2.7997	- 1.0958
0.07	3.2384	- 2.9890	- 1.0834
0.08	3.4289	- 3.1991	- 1.0718
0.09	3.6432	- 3.4336	- 1.0610
0.10	3.8861	- 3.6972	- 1.0511
0.11	4.1636	- 3.9960	- 1.0420
0.12	4.4839	- 4.3378	- 1.0337
0.13	4.8576	- 4.7331	- 1.0263
0.14	5.2992	- 5.1962	- 1.0198
0.15	5.8291	- 5.7470	- 1.0143
0.16	6.4768	- 6.4146	- 1.0097
0.17	7.2864	- 7.2425	- 1.0061
0.18	8.3273	- 8.2992	- 1.0034
0.19	9.7152	- 9.6997	- 1.0016

Таблица 2.

Значения интегралов (14) и (15) для $a = 2$

t	$J_1(t)$	$J_2(t)$	$k = J_1(t):J_2(t)$
0.00	2.3316	- 2.2950	- 1.0160
0.01	2.4288	- 2.3978	- 1.0129
0.02	2.5344	- 2.5085	- 1.0103
0.03	2.6496	- 2.6284	- 1.0081
0.04	2.7758	- 2.7587	- 1.0062
0.05	2.9146	- 2.9011	- 1.0046
0.06	3.0680	- 3.0576	- 1.0034
0.07	3.2384	- 3.2307	- 1.0024
0.08	3.4289	- 3.4233	- 1.0016
0.09	3.6432	- 3.6393	- 1.0011
0.10	3.8861	- 3.8835	- 1.0007
0.11	4.1636	- 4.1621	- 1.0004
0.12	4.4839	- 4.4830	- 1.0002
0.13	4.8576	- 4.8571	- 1.0001
0.14	5.2992	- 5.2990	- 1.0000
0.15	5.8291	- 5.82 90	- 1.0000
0.16	6.4768	- 6.4768	- 1.0000
0.17	7.2864	- 7.2864	- 1.0000
0.18	8.3273	- 8.3273	- 1.0000
0.19	9.7152	- 9.7152	- 1.0000

Полученные численные результаты позволяют сделать следующие *выводы*:

1. С течением времени t точки x_3 и x_4 , в которых достигаются нулевые значения функции $\xi(x, t)$, постепенно «перемещаются» в сторону начала ($x = 0$) координатной системы. Также, в том же направлении, происходит перемещение точек минимума функции x_1 и x_2 .

2. Абсолютные величины максимума ξ_{max} (максимальное значение в точке $x = 0$) и минимума ξ_{min} функции, определяющей границы между слоями, (минимальное значение в точках x_1 и x_2) увеличиваются с течением времени t , и могут достигнуть достаточно больших значений. Причем, с некоторого момента времени этот рост значений функции может иметь значительную величину, и в предельном значении $t \rightarrow 0.25$ значение функции стремится к бесконечности $\xi(x, t) \rightarrow \infty$.

3. Площадь области поднятия также увеличивается, несмотря на «сужение» графика функции с течением времени. С течением времени t площади поднятых $J_1(t)$ и опущенных $J_2(t)$ областей имеют тенденцию стать численно равными.

4. Сравнение результатов вычислений площадей поднятий $J_1(t)$ и опусканий $J_2(t)$ для различных значений параметра a показало, что если ширина ограничений по горизонтали больше ($a = 2$), то этот процесс достигается раньше чем при меньшем значении этого параметра ($a = 1$). Очевидно, что если рассматривается бесконечная область $-\infty \leq x \leq \infty$, то площади поднятий и опусканий будут равными. Это означает, что материалы верхнего, более плотного, слоя будут перемещаться так, что успеют заполнять возникающее пространство, вызванное поднятием материалов нижнего слоя.

Заключение. Уравнение (1), полученное в результате математического моделирования процессов, происходящих в двухслойной вязкой жидкости, когда нижний слой имеет меньшую плотность, имеет особенность, которая заключается в наличии отрицательного знака при старшей производной, имеет общее решение в виде функции (2). Получено общее решение задачи для данного уравнения. Проведенный анализ полученного решения показал, что оно достаточно наглядно описывает процесс гидродинамической неустойчивости, происходящий на границе между двумя слоями жидкости, когда она ограничена между двумя «стенками».

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MEDICAL SCIENCES

УДК 616.31+616.12-008.331.1

THE ROLE OF BOTH FAMILY DOCTOR AND DENTIST IN THE EARLY DETECTION OF VESICOVASCULAR SYNDROME AS A MEASURE FOR THE PREVENTION OF HYPERTENSION DISEASE

Ibrahimov M.,

*Candidate of Medical Sciences, Associate Professor of the Department of Family Medicine,
Azerbaijan Medical University*

Bayramov G.,

*Candidate of Medical Sciences, Assistant of the Department of Therapeutic Dentistry,
Azerbaijan Medical University*

Aliyeva G.,

*PhD, Assistant of the Department of Therapeutic Dentistry,
Azerbaijan Medical University*

Ibrahimova L.

*assistant of the Department of Therapeutic Dentistry,
Azerbaijan Medical University*

РОЛЬ СЕМЕЙНОГО ВРАЧА И СТОМАТОЛОГА В РАННЕМ ВЫЯВЛЕНИИ ПУЗЫРНО-СОСУДИСТОГО СИНДРОМА КАК МЕРА ПРОФИЛАКТИКИ ГИПЕРТОНИЧЕСКОЙ БОЛЕЗНИ

Ибрагимов М.А.

*к.м.н., доцент кафедры Семейной Медицины,
Азербайджанский Медицинский Университет*

Байрамов Г.Р.

*к.м.н., ассистент кафедры терапевтической стоматологии
Азербайджанского Медицинского Университета*

Алиева Г.Г.

*к.м.н., ассистент кафедры терапевтической стоматологии,
Азербайджанский Медицинский Университет*

Ибрагимова Л.К.

*ассистент кафедры терапевтической стоматологии
Азербайджанского Медицинского Университета*

<https://doi.org/10.5281/zenodo.7533520>

Abstract

Doctors have long noticed that the oral cavity is an indicator that warns of the development of any general disease. As you know, our organism is a single whole and therefore the first manifestations of the disease can be found in the oral cavity. One of the symptoms of disorders in the organism can be vesicovascular syndrome. It often manifests itself in people with blood hypertension (BH) [1]. Currently, BH is quite widespread and is one of the causes of death and disability of the patients. Diagnosing the disease at an early stage is the first step to its successful treatment, since the disease is easier to cope with in the initial period and the likelihood of complications is less. An important role in the prevention of hypertension is played by a dentist and a general family doctor, since one can suspect the disease, and the other can prescribe necessary examinations, treatment and preventive measures.

Аннотация

Врачами давно замечено, что ротовая полость является индикатором, предупреждающим о развитии какого-либо общего заболевания. Как известно, весь наш организм - единое целое и, поэтому первые проявления болезни можно обнаружить в полости рта. Одним из симптомов нарушений в организме может служить пузырно-сосудистый синдром. Он часто проявляется у людей с гипертонической болезнью (ГБ) [1]. В настоящее время ГБ достаточно широко распространена и является одной из причин смертности и нетрудоспособности пациентов. Диагностирование заболевания на раннем этапе - первый шаг к ее успешному лечению, так как с болезнью легче справиться на начальном периоде и вероятность осложнений меньше. Большую роль в профилактике гипертонической болезни играют стоматолог и семейный врач общего профиля, так как один может заподозрить заболевание, а второй назначить необходимые обследования, лечение и профилактические мероприятия.

Keywords: hypertension, vesicovascular syndrome, general family doctor, prevention.

Ключевые слова: гипертоническая болезнь, пузырно-сосудистый синдром, семейный врач общего профиля, профилактика.

Введение. Одной из актуальнейших проблем медицины в настоящий момент является гипертоническая болезнь. Если обратиться к статистике, то можно увидеть, что сердечно-сосудистые заболевания занимают одно из ведущих мест среди причин смертности в мире.

Если раньше считалось, что данной болезнью страдают только взрослые, то сейчас её часто можно наблюдать среди подростков, а иногда и школьников.

В сложившихся обстоятельствах все большее значение приобретает профилактика данного заболевания. Одной из мер профилактики АГ может служить раннее выявление пузырно-сосудистого синдрома. Он проявляется в виде образования плотных пузырей в ротовой полости [2]. Огромная роль при этом отводится семейному врачу общего профиля и стоматологу, так как именно к ним при появлении дискомфорта обращаются пациенты [3; 4].

Материалы и методы. Основными методами при написании статьи были теоретический анализ, а также обобщение. Было изучено огромное число работ как отечественных, так и иностранных ученых о роли семейного врача общего терапевта и стоматолога в раннем выявлении пузырно-сосудистого синдрома в полости рта как мера профилактики АГ.

Результаты исследования. Гипертоническая болезнь – это патология, при которой наблюдается повышение артериального давления [5]. У людей, имеющих данное заболевание, можно наблюдать изменения в ротовой полости. На слизистой оболочке появляются пузыри с геморрагической жидкостью. Они могут быть разного размера, одиночные и множественные. Пузыри возникают внезапно и могут в неизменном состоянии находиться как несколько часов, так и дней. Они могут рассосаться либо вскрыться. При последнем варианте можно наблюдать эрозию, заживающую в течении 3-7 дней [6].

Стоматолог – это специалист, к которому сразу же обращаются пациенты при появлении дискомфорта, болей и пузырей в полости рта. Именно он первый может заподозрить АГ [7]. Поэтому, обнаружив изменения в ротовой полости, стоматолог сразу же направляет пациента к семейному врачу для дальнейшего обследования и лечения. Точно поставить диагноз может только семейный врач общего профиля. Ранее обнаружение пузырно-сосудистого синдрома может являться действенной мерой профилактики АГ.

Профилактические мероприятия артериальной гипертензии включают в себя:

- отказ от таких вредных привычек, как курение и алкоголь;
- постоянное отслеживание холестерина в крови;
- занятие спортом;
- контроль АД;
- рациональное питание;
- правильный и четкий распорядок дня;
- похудение, если наблюдается ожирение;

- избегание стресса [8].

К вторичной профилактике АГ относят лекарственную терапию и немедикаментозные методы (например, строгая диета). Она в основном направлена на предотвращение появления осложнений [9].

Выполнение профилактических мероприятий в большинстве случаев помогает остановить развитие болезни. Однако их несоблюдение, может привести к быстрому прогрессированию болезни и появлению таких грозных осложнений как инфаркт миокарда или инсульт. АГ – хроническое заболевание, с которым тяжело бороться, поэтому легче его предупредить.

ЗАКЛЮЧЕНИЕ. Все процессы, происходящие в организме человека, взаимосвязаны. Пузырно-сосудистый синдром это одно из проявлений АГ, которое может свидетельствовать о развитии болезни, еще до развития основных симптомов [10]. Ранее выявление данных изменений является одной из мер профилактики основного заболевания. Методов первичной профилактики должны придерживаться все люди, желающие быть здоровыми. Они направлены на предотвращение развития болезни. Только благодаря слаженной работе семейного врача и стоматолога можно добиться успеха в профилактике и лечении как самой гипертонической болезни, так и ее проявлений в ротовой полости.

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PEDAGOGICAL SCIENCES

UOT 37.01

INTERPRETATION OF THE "SUBJECT CONTENT BLOCK" ELEMENTS OF THE TECHNOLOGY SUBJECT CURRICULUM AT THE GENERAL EDUCATION LEVEL BASED ON THE "SYSTEM-STRUCTURE" APPROACH

Ibrahimov F.N.,

*Sheki branch of ADPU, doctor of pedagogical sciences,
professor*

<https://orcid.org/0000-0002-0775-1048>

Ibrahimova S.F.

Sheki branch of ADPU, honored teacher, senior teacher

<https://doi.org/10.5281/zenodo.7525628>

Abstract

In the article, it is emphasized that the curriculum reform is conditioned by the need to ensure the adequacy of the implementation of education to the demands of the 21st century, to train a creative, self-developing personality, and the content of the abilities that must be transformed into the subject of the student who has completed his general education is shown.

The importance of the educator's reference to the "system-structural approach" in the research work both in familiarizing himself with the essence of the educational program and in his practical activities related to its implementation, the relevance of subject-oriented curricula to the content of the scientific field, the attention directed to the mastery of these concepts directly by covering its perfect system of concepts is drawn to the center.

In the article, the "block-scheme" form of the structure of the Technology subject curriculum at the general education level, the general learning results, content lines, learning results on content lines, content standards, integration concepts included in the "Content of the subject" block, generalizations made on the basis of the "system-structure" dialectical approach interpretation is presented.

Keywords. *Educational program; curriculum; subject curriculum; "block-scheme" form; overall learning outcomes; content line; content standards; content elements; educational stages and levels; lines of action; household culture; processing technologies; technical elements; graphic.*

Relevance of the research topic.

Observations show that mistakes are made in the activities of educators in the application of the Technology subject curriculum at the general education level. This has a negative effect on the level of efficiency of the teaching process of Technology. It is undeniable that the level of understanding of any real thing has a determining effect on the results of using it in adequate directions. Based on our scientific observations over the past ten years, we have come to the conclusion that the mistakes manifested in the activities of practical educators in the process of using the Technology subject curriculum are based on a number of reasons, as well as a lack of honest understanding of the essence of the Technology subject curriculum by these subjects. Based on our scientific experience, we believe that "system-structure" approach is the most reliable dialectical method of understanding any existing thing, getting to its essence. The analysis of the materials we have collected gives reason to say that this method has not been used enough in the theoretical and technological directions regarding the discovery of the essence of the Technology subject curriculum and the determination of its application ways. Therefore, we claim that one of the issues that lead to the solution of the problem, which is the basis for the manifestation of the mistake given above, should be formulated as "Interpretation of the elements of the "Content of the Subject"

block of the Technology subject curriculum at the general education level based on the "system-structural" approach" and that it should be an actual research topic. The analysis of the materials we have collected gives reason to say that this method has not been used enough in the theoretical and technological directions regarding the discovery of the essence of the Technology subject curriculum and the determination of its application ways. Therefore, we claim that one of the issues that lead to the solution of the problem, which is the basis for the manifestation of the mistake given above, should be formulated as "Interpretation of the elements of the "Content of the Subject" block of the Technology subject curriculum at the general education level based on the "system-structural" approach" and that it should be an actual research topic. The analysis of the materials we have collected gives reason to say that this method has not been used enough in the theoretical and technological directions regarding the discovery of the essence of the Technology subject curriculum and the determination of its application ways. Therefore, we claim that one of the issues that lead to the solution of the problem, which is the basis for the manifestation of the mistake given above, should be formulated as "Interpretation of the elements of the "Content of the Subject" block of the Technology subject curriculum at the general education level based on the "system-structural" approach" and that it should be an actual research topic.

Interpretation of generalizations formed on the basis of research materials.

It is known that in the 21st century, the main value in the life and development of both society and each of its members is a creative, self-developing personality [14; 16]. Education also cannot exist outside the realities of a changing world. Modern psychology considers the creation of favorable conditions for the discovery and realization of the child's creative abilities as the main goal of education [6; 290-292]. Therefore, since the main value in the modern period is a creative, self-developing personality, the educational process should form creativity and self-development abilities in the child. This, in turn, is based on the following activity, the need to understand and the abilities: 1) logical thinking; 2) critical approach to objects and events of the surrounding world; 3) independent decision-making; 4) change the surroundings at a creative speed; 5) independent acquisition of knowledge; 6) solving practical problems; 7) setting new goals for personality development.

The skills that a student who has completed his general education should acquire - the general learning results are formed as a synthesis and dialectical unification of the results targeted in the teaching process of all subjects taught in general education schools (including the subject of Technology).

It is undeniable that it is of particular importance for the teacher teaching Technology to honestly know the tasks set before the general education (general expected results). However, this is one side of the issue and it is necessary to put the activity related to the educational process into a result-oriented system. Thus, the goal is the system-creating component of the activity. At the same time, it is very important to implement the training process in what content, based on what strategy, based on what evaluation mechanisms, in order to achieve the goal. "The new necessary minimum of education at the levels of general education, knowledge limit, linking the general learning outcomes and skills to be acquired in the subject with the learning outcomes to be achieved at separate levels of general education is considered one of the most important problems of education" [11; 71]. The teacher should be able to find both theoretical and practical answers to all questions related to the learning process. He should know which model he uses in the process of which he is a facilitator and what are the specific features of this model. This model incorporates the superior merits of traditional models (it should not be forgotten that innovation is not a complete denial of the old, such a denial can bring more harm than good) and what success it promises to the real pedagogical process. Based on what we have said, we summarize that the "effective organization of all activities related to the educational process" currently applied in general education schools,

The teacher is one of the subjects of the "enabling function" in the implementation of the educational program. The level of his penetration into the essence of the mentioned program has a conditioning effect on the effectiveness of its activity. Therefore, it is important to refer to the "system-structure" approach both in familiarizing with the essence of the program and in the prac-

tical activities related to its implementation, the analysis of research materials and our work experience brings us to this conclusion.

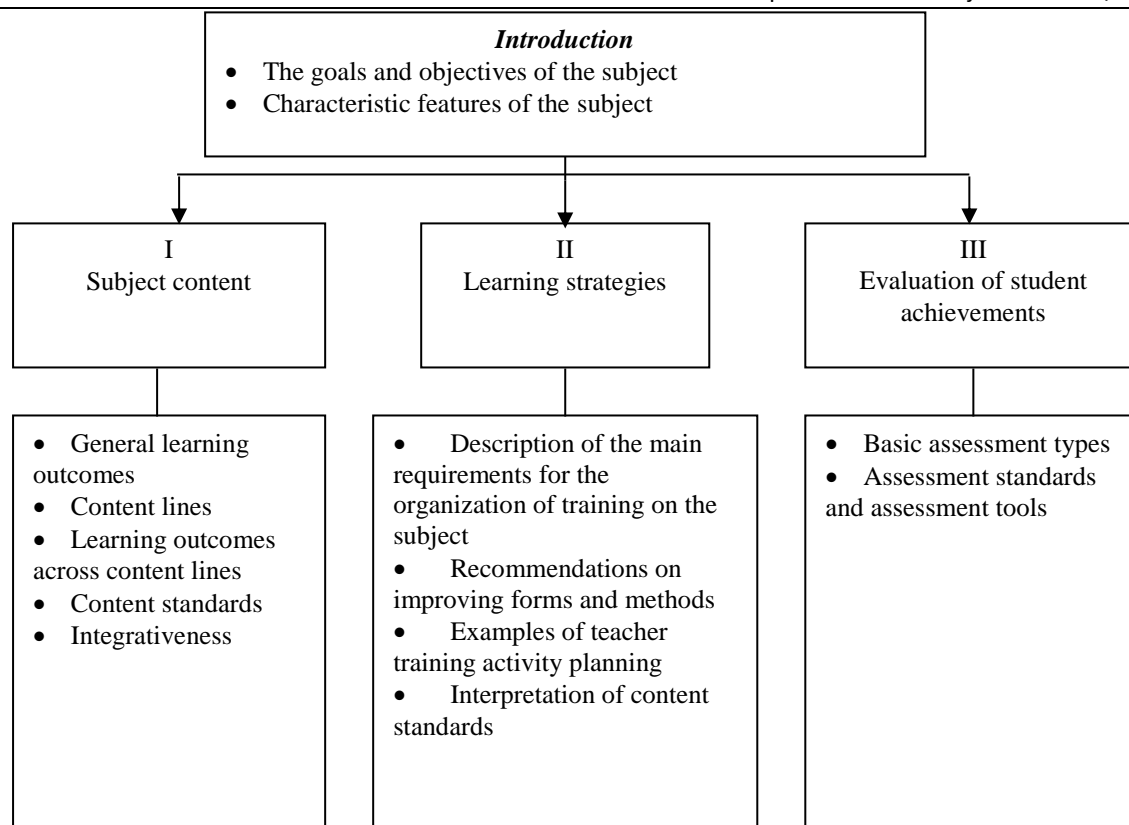
It should be emphasized here that the essence of the system is determined by its structure and function, that is, by the nature of the relationship between the elements and their behavior, and by the specificity of the relationship between the object and the conditions. Without studying the elements that make up the system and their mutual influence, it is impossible to distinguish the continuous, important and necessary relationships here. Such continuous, important and necessary interaction of elements characterizes the structure of the system. The law of relationships of structural elements acts as an invariant of the system. Without learning and opening the relationship of the elements with the whole formed by them, both the function of the system and the functions of each element with regard to the whole remain in the shadows. The full concept is understood in terms of the system, it is the organization of that system. Each system has its own structure and the function that this structure carries. A system can be viewed as a whole consisting of the unity of its structure and function. Systems differ from each other not only by their structure and functions, but also mainly by the nature of the unity of structure and function, the nature of this unity.

The educational program (curriculum) determines the content of education and the rules of mastering it for different levels of education in accordance with state educational standards [8; 106-107]. The educational program includes the curriculum, curricula for subjects, recommendations on methodical provision, assessment and other relevant educational technologies [7; 173]. Educational curricula are divided into two types according to their nature: functional and personality oriented

Science-oriented curricula are directly oriented to the assimilation of these concepts by covering the field of science and its perfect system of concepts in terms of content. Personality-oriented curricula are distinguished by their direct emphasis on life skills and habits. "Personality-oriented", "pupil-oriented" and "result-oriented" approaches of the curriculum indicate that the student is at the center of the learning process"[13].

Subject curricula (including the Technology subject curriculum): take a balanced and comprehensive approach to learning different skills; enables achievement of content standards using active learning methods; implies constant assessment of students' knowledge and understanding, making corrections during the academic year; ensures the involvement of students in training, preparation and motivation for continuous education; it envisages the use of modern technologies while studying, evaluating students' knowledge, improving their literacy; has adequate training resources and administrative support.[4; 189-190]

The block diagram form of the structure of the subject curriculum (as well as the Technology subject curriculum) can be drawn as follows [9; 38] (see scheme 1)



Scheme 1

Summing up, it can be said that the curriculum of the subject of Technology is a set of documents that reflect all the activities aimed at achieving the general learning results by setting the main goals of the teaching of this subject in secondary schools and are directed to the capabilities and needs of each student. It is intended for teachers, school leaders, textbook authors, parents and the general public. The subject curriculum is the basis of the rules to be prepared in the form of appropriate guidelines for the preparation of textbooks and teaching aids, planning of teaching materials, determination of teaching methods and implementation of teacher training.

In the process of defining content standards, the focus is on the expected balance of the main learning outcomes for the subject (calculation procedural skills, cognitive understanding and problem solving). This curriculum presents key learning outcomes through the interaction of content and action lines to determine what students should "know" and "be able to do".[14]

The document included in the "Introduction" block allows determining the place of the Technology subject among the subjects taught in general education schools, as well as the general definition of the main goals of its teaching.

The teaching of the subject "Technology" in secondary schools creates comprehensive conditions for students to use processing technologies in their independent life, to form their creative abilities, and to continue their education in technical fields. In the training process, students determine the possibilities of technical activity, propose ideas for solving problems, perform simple technological tasks and get the opportunity to evaluate the results. At the same time, the teaching

of this subject lays the foundation for shaping the character of students, their spiritual, intellectual and aesthetic development, and their adaptation to socio-economic conditions by acquiring technological skills appropriate to the era.

In addition, through this subject, students are prepared for productive work in different service areas, their polytechnic worldview is expanded and conscious career choices are ensured.

By studying this subject, students get acquainted with computer equipment and modern technologies in detail, acquire knowledge and skills related to processing technologies in production, and acquire the ability to solve problems.

The purpose of the "Technology" subject is to ensure that students prepare for independent life, mass and promising professions in new socio-economic conditions, acquire general skills and habits, and easily adapt to various conditions based on creative thinking and active activity.

As it is known, "revealing the child's creative possibilities and realizing them, creating favorable conditions for the formation of his personality is one of the main goals of education" [9; 290-292]. There is no doubt that subjects, which are the main enabling components of the implementation of general education, are of high value as an important tool in the formation of the personality of schoolchildren. The "enabling" functions of the subjects are expressed in the "Education Law of the Republic of Azerbaijan" in the following content:

-ensures that students are taught the basics of science, inculcated the necessary knowledge, skills and habits, prepare them for life and work;

-enables physical and intellectual development of students, acquisition of necessary knowledge, formation of civic thinking based on healthy lifestyle and civilized values, inculcation of respect for national and worldly values, determination of rights and responsibilities in front of family, society, state and environment[2; 21-23].

Based on the official state documents, we can say that "... the content of general education subjects aims at the following iyearxic goals by focusing on different levels of education":

- to improve reading, writing and calculation skills in primary education, to form basic knowledge about man, society and nature, elements of logical thinking, aesthetic and artistic taste and other characteristics;

- oral speech and writing culture, communication skills, cognitive activity, the development of logical thinking, the formation of relevant knowledge and ideas about the subjects included in the educational program as well as the development of world civilization, the ability to use modern information and communication tools, events to provide the ability to evaluate and determine their own future directions of action;

- realization of talents and abilities, preparation for independent life and professional choice, formation of an active citizen position, respect for national and universal values, human rights and freedoms and tolerance, free use of modern information and communication technologies and other technical means, acquiring the basics of economic knowledge, communicating in

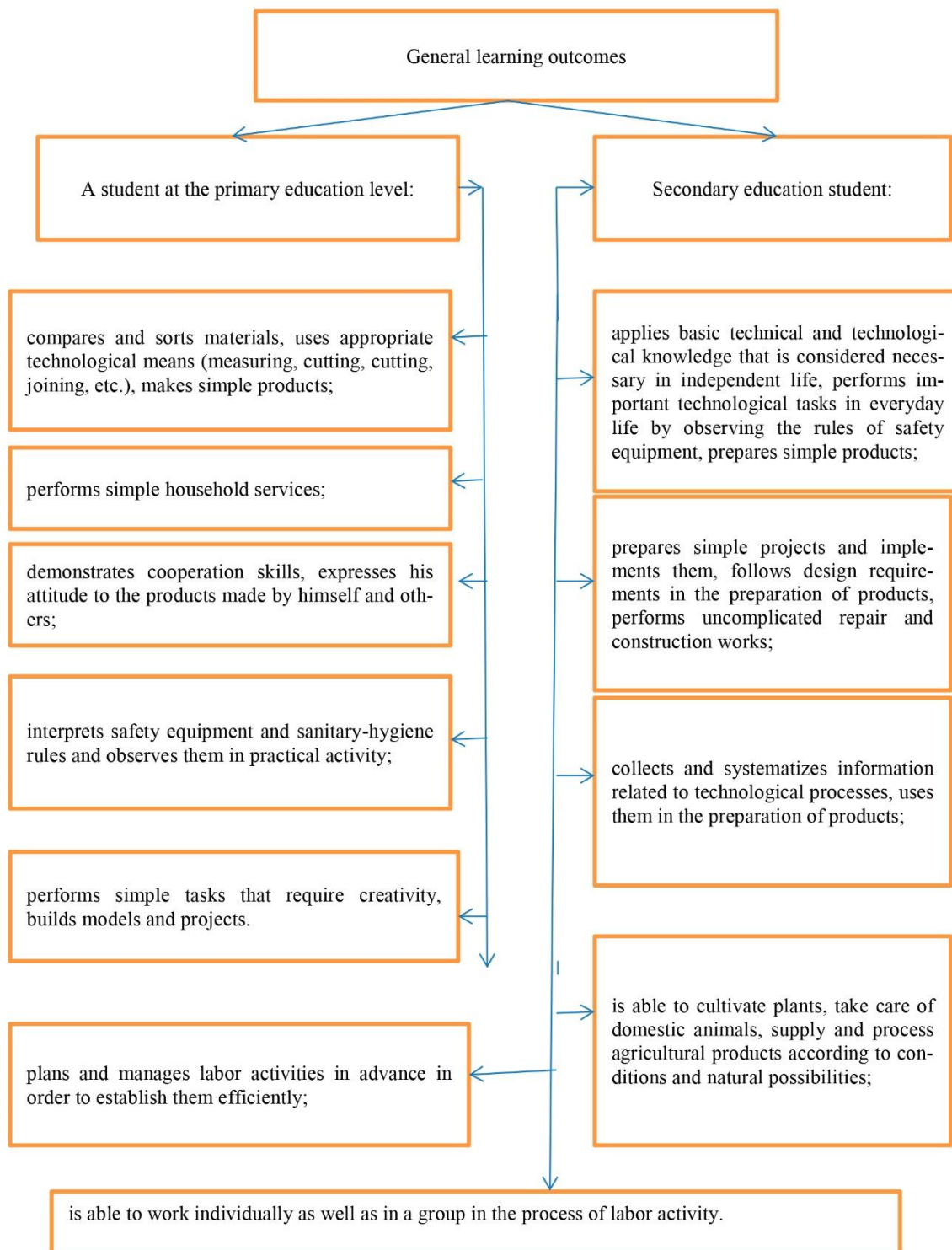
one or more foreign languages, etc. provide (see [1] for more information).

In the mentioned system of knowledge, skills and habits, what is obtained at different educational levels in the teaching of Technology is included as a component. The relevance of the mentioned components has found its expression in the official document. In accordance with the framework document "Concept of general education in the Republic of Azerbaijan (National Curriculum)", the tasks of the subject "Technology" in secondary schools are defined as follows:

At the primary education level, students are trained in comparison and sorting, primary processing, self-service and cooperative habits, simple design, layout, modeling, design, living nature service skills, measurement, proportion, symmetry and other geometric concepts, the ability to perform simple constructions and creative works. Vaccination is provided.

At the basic education level, by developing the activities intended for the fulfillment of the functional tasks set at the primary education level, improving technological and applied skills, implementing non-simple technological processes, forming creative technical thinking, expanding students' opportunities to use modern information technologies, guiding them to choose a profession, diligence and education in the spirit of creativity is ensured.

The general learning outcomes of the technology subject can be schematically described as follows (scheme 2):



Scheme 2

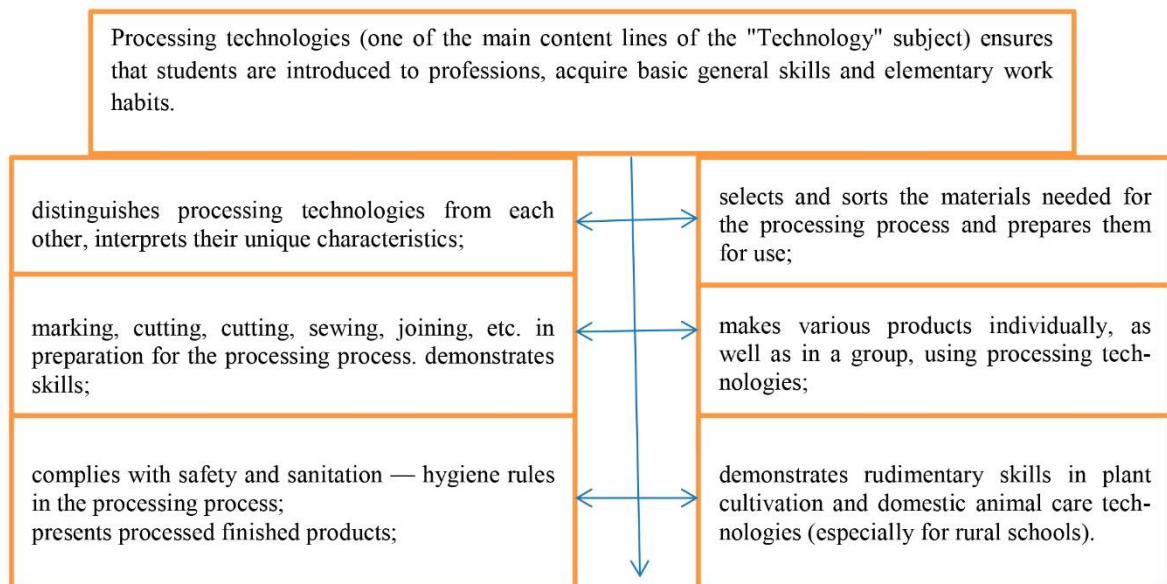
The content line is the part of the content that is considered necessary to ensure the realization of the general learning outcomes of the subject. Content lines are defined to more clearly describe the content that students will learn and aim to systematize it.

As a result of the study of national and world experience, their comparison and analysis, the below-mentioned content lines of the subject "Technology" have been determined, which serves the purpose of more clearly describing and systematizing the

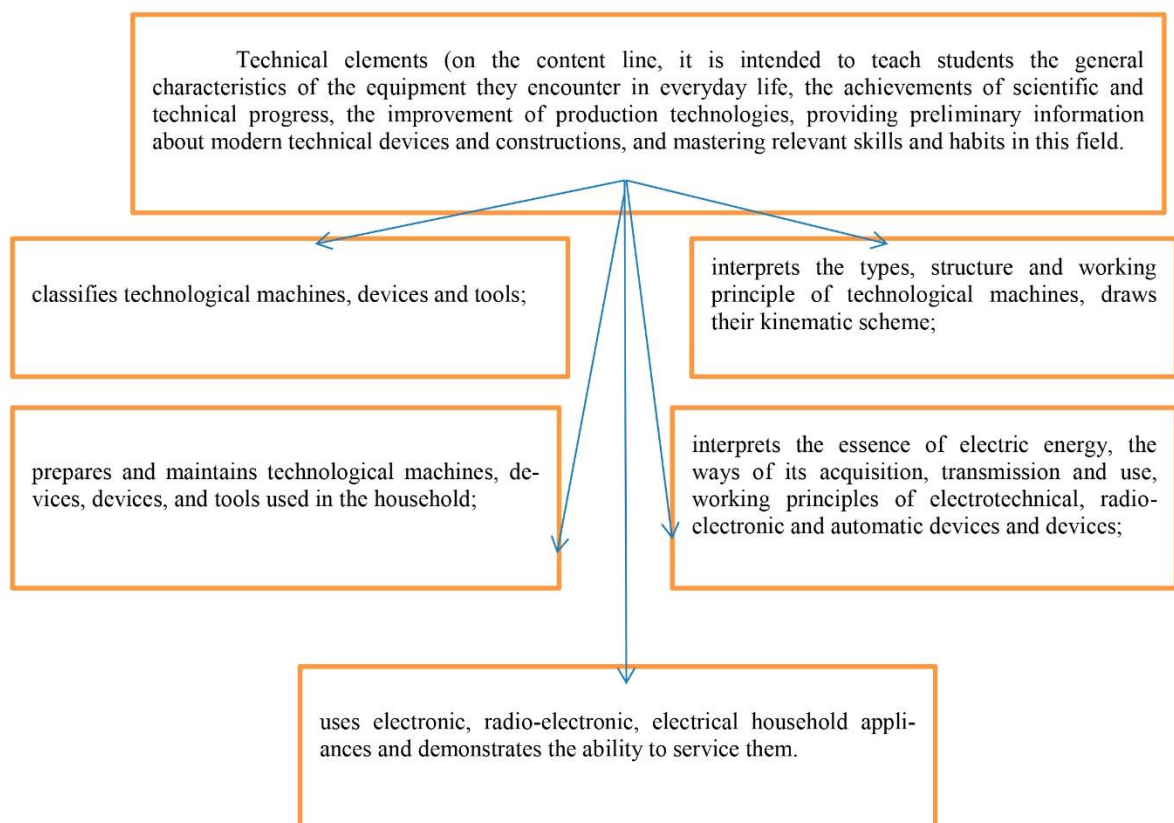
knowledge and skills that students will acquire: Processing technologies; Technical elements; Household culture; Graphic.

As in all subjects, although the content of the technology subject is enriched from class to class, from simple to complex, from easy to difficult on a concentric basis, the content lines remain unchanged.

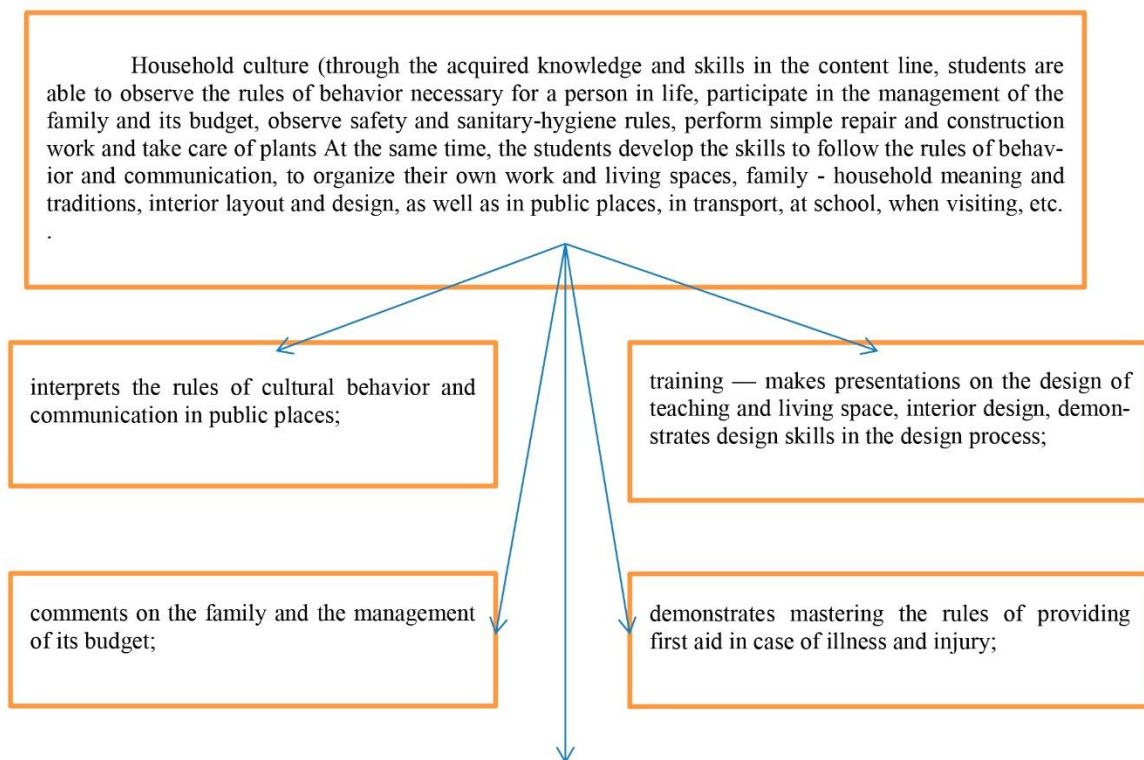
It is possible to give a schematic description of the general training results by content lines as follows (Scheme 3.1; 3.2; 3.3; 3.4):



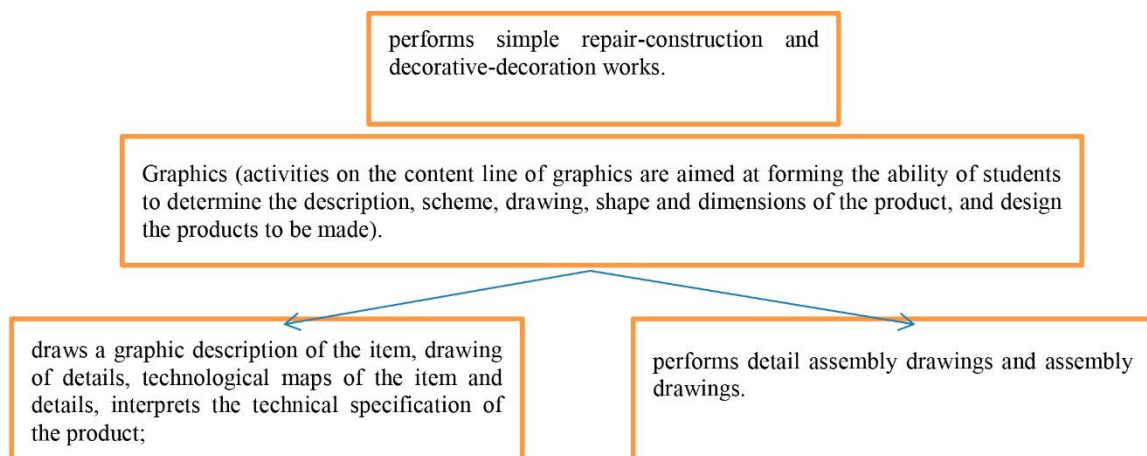
Scheme 3.1



Scheme 3.2



Scheme 3.3



Scheme 3.4

The content lines of the technology subject serve to structure the curriculum and, in this case, conduct reasoning. It should be noted that any concepts or skills included in the content of the subject may not be limited to only one content line. When determining the content lines, it is assumed that each of them will be given equal importance in the teaching of the Technology subject. As the content of the subject varies from grade to grade, the content of each of the lines and their weight in the overall content varies considerably.

A curriculum designed along content lines should cover a wide range of content. Taught in an integrative way, this broad content allows students to understand the interrelationship of various vital knowledge not only within the subject of Technology, but also in other subjects and in real life.

It is emphasized in scientific sources that the content standard is the state requirement set for the level of knowledge and skills of the student [3;468]. The standards for the subject of technology cover the content that is important for all students within the secondary education course, describe the knowledge and skills of students in the subject of technology, determine the issues that every student in the country can and should learn in the field of life sciences, and prepare students for the next level of secondary education.

The new approach to setting the content of the standards envisages that each standard consists of several defined objectives (sub-standards) and is repeated throughout the grades in an appropriately expanding capacity.

The content standards of the technology subject are systematized by classes and represented by the

above four content lines. Each standard goal includes several expected learning outcomes defined according to the primary, secondary education levels. The components of technology teaching and learning are not isolated from each other, but rather they are interconnected and complement each other.

The function of the core standard is to explain the defined learning outcomes in a general way along the content lines. It is related to the functions of sub-standards: it creates a reliable basis for the precise determination of learning objectives; plays an important role in the correct selection of training strategies; ensures integration in training; ensures continuous development of training content; provides summative assessment for classes and subjects.

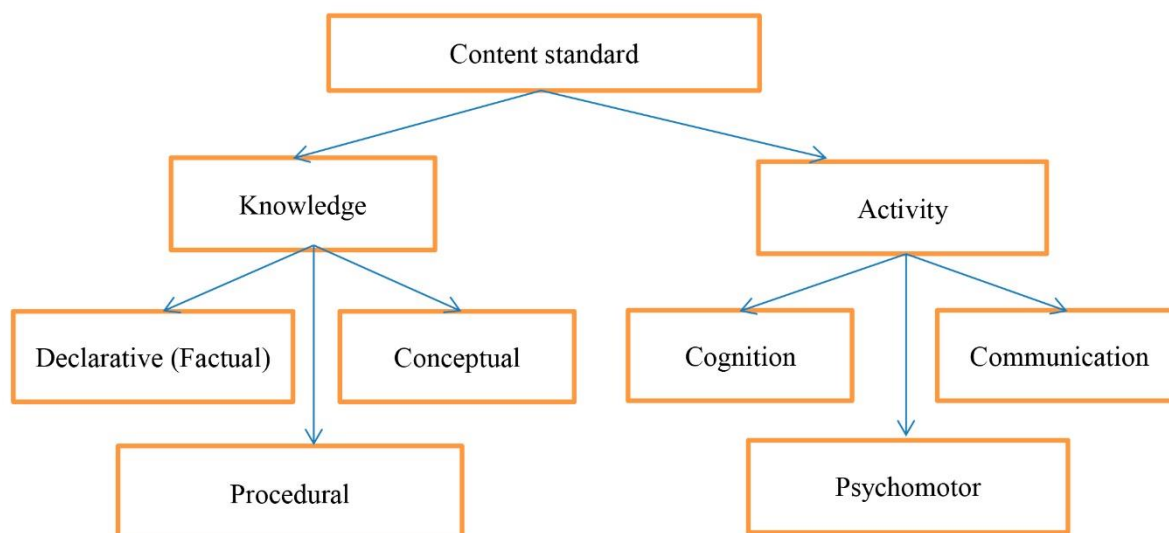
Implementation of content standards in the subject "Technology" is carried out along the following lines of action: Problem solving; Analysis and reasoning; Non-judgmental; Communication; Presentation.

While action lines are distinct from content lines, they are related to each of them. These lines aim to define and describe ways of acquiring and using content

knowledge, and serve to help students understand the importance of computer science and view it as a set of complex skills.

The student can achieve the content of the subject of Technology through various activities. Different stages of student activity in the process of mastering the content ensure that the acquired knowledge and skills are more solid and long-lasting. Performance standards ensure that students master the content standards for implementing the curriculum. Each performance standard describes what is covered in the grade and what the teacher's role is in achieving the content standard. It should be noted that each performance standard varies across educational levels and grades, with use in all grades. Therefore, it is convenient to adopt these standards in general.

Knowledge and action components of content standards, their classification is as follows (see scheme 3)



Scheme 3

Curriculum theorists have identified verbs that represent all stages of all three taxonomies (cognitive, emotional, psychomotor) considered useful for education to aid standard setters. Verbs are a very important indicator in expressing skills. The verb reflects the stage of taxonomy of the skill. [10; 41]

Taxonomies make learning more consistent and efficient. Taxonomies play a major role in the learning process. They provide the following opportunities: correctly define training goals; correctly define problems and design tasks for students; choose evaluation tools according to the set goals; properly conduct reflection based on learning outcomes; to determine what difficulties students face in learning this or that material.

The formation of knowledge, skills and habits that students can acquire and apply in their daily lives in the educational process requires the teaching of both subjects and the topics they cover in a connected-integrative way. Integration is to form a whole and indivisible image of the world in the thinking of students within

the framework of a certain educational system, to establish structural connections between all content components of training and to systematize them in order to direct them to development and self-development. In modern world experience, they distinguish 3 levels of integration.

Intra-subject integration is the systematization of the facts within the subject, the integration of concepts, knowledge and skills instilled in a certain subject. Integration at such a level can also be considered as the concentration of the given material in separate educational units. This ultimately leads to changing the structure of the subject's content. In this sense, Integrated content becomes more innovative, helps students to develop thinking skills with more comprehensive categories. Interdisciplinary integration can be both horizontal and vertical.

Rapid social, cultural and technological changes in the modern world greatly increase the importance of a

global mindset. In this case, in the learning process, students are not passive consumers of the knowledge and skills given in individual subjects, but on the contrary, it leads to being treated as subjects who have a creative attitude towards understanding the world around them. This is possible when the subjects studied at the educational levels and the topics covered by them are taught not separately, but in a connected-integrative way. Interdisciplinary integration is the synthesis of concepts, knowledge, skills and principles covered by two or more disciplines. This integration involves the expression of laws, theories and methods related to one discipline in the study of another discipline. Systematization of the content according to this model not only creates a whole and indivisible image of the world in students' thinking, but also promotes the formation of a new type of knowledge characterized by universal concepts, categories and approaches. Similar and complementary topics of different subjects are planned and taught in such a way that a certain framework is created for them, that is, they are taught simultaneously.

Cross-curricular (trans-subject) is the highest level of integration and includes the synthesis of the main and additional content components covered by the training. That is, with this integration, the content that students learn at school and the content they receive outside of school are synthesized. , it requires both the change of educational paradigms and the idea of forming a new generation in communities.[5; 171]

The teaching of integrative subjects such as life science involves not only intra-subject, interdisciplinary and supra-disciplinary integration, but also the integration of teaching methods and technologies.

Scientific novelty and theoretical significance of the research work.

1) The importance of the application of the "system-structure" approach method, formed as an important branch of the dialectic regarding the discovery of the essence of the technology subject curriculum and the determination of its application methods, has been brought to the attention of researchers; 2) "The solution of one of the cognitive issues that determines the solution to the problem of revealing the essence of the Technology subject curriculum at the general education level and developing its application in the optimal version - the interpretation of the "Technology subject content" block based on the "system-structure" approach" was presented.

Practical significance of the research work. We hope that the solution of one of the important cognitive issues that determine the solution to the problem of revealing the essence of the Technology subject curriculum applied at the general education level and its application in the optimal version - the "interpretation of the "Technology subject content" block" on the basis of the system-structural approach" will be presented in the application of the Technology subject curriculum will have a positive effect on the formation of the environment of elimination of mistakes manifested in the activities of educators.

The result.

1) The level of understanding of any real thing has a determining effect on the results of taking advantage

of it in adequate directions; 2) Mistakes in the activities of educators in the application of the Technology subject curriculum at the general education level have a negative effect on the level of efficiency of the Technology subject teaching process; 3) In the process of using the technology subject curriculum, the basis of the mistakes manifested in the activity of practical educators is based not only on one of the reasons, but also on the lack of honest enough understanding of the essence of the technology subject curriculum by these subjects; 4) "System-structural approach" is the most reliable dialectical method of understanding any existing thing, getting to its essence; 5) The "system-structure" dialectical method of the "system-structure" approach was not used in the theoretical and technological directions regarding the discovery of the essence of the technology subject curriculum and the determination of its application methods; 6) One of the cognitive issues aimed at solving the problem that creates the basis for the manifestations of the error caused by the "gap" regarding the discovery of the essence of the technology subject curriculum and the determination of the ways of its application is "Interpretation of the elements of the "Subject Content" block of the subject curriculum at the general education level based on the "system-structure" approach" and the presented research in this direction benefits the teaching process of our subject.

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TEACHERS' PERCEPTIONS OF FORMING SOCIOCULTURAL COMPETENCE AMONG SECONDARY SCHOOL STUDENTS IN ENGLISH CLASSES

Ilesbekova B.

Kazakh Ablai Khan University of International Relations
and World Languages, Almaty, Kazakhstan
<https://doi.org/10.5281/zenodo.7525646>

Abstract

This article was written in order to determine the cause of the problem of the formation of a certain competence of students in the English lesson in accordance with the changes made to the education system of Kazakhstan. The question included in the article is aimed at the formation of the current socio-cultural competence of schoolchildren through foreign language lessons. And do all teachers fulfill this requirement, or do they accept sociocultural competence as a necessary and important skill? According to the results of the survey conducted during the writing of the article, it was determined and analyzed how teachers of different levels take responsibility for this competence.

Keywords: competence, sociocultural competence, formation of sociocultural competence, teachers' perception, English classes

Introduction

The intense political, social and economic transformations in the society of Kazakhstan under the influence of global development led to radical changes in the education system. The directions in the education system are determined according to the requirements of modern society [1]. In addition, the goals and objectives of education in the education system are constantly updated in the strategic plan of each period. One of them is to educate competent and qualified generation starting from the school walls so that the citizens of the state can become competitive individuals [2].

According to the state program of education and science development of the Republic of Kazakhstan for 2020-2025, combining the socio-economic development of the country with science, the main goal is to increase the literacy level of citizens by eliminating regional differences, to learn foreign languages in depth, and to form the competencies inherent in a highly intelligent person [3]. Supplementing the aforementioned legislative program with such directions was directly related to the progress of the modern innovative and integrated borderless society.

The modern education system requires the development of critical thinking ability of a person, the ability to analyze it and express one's point of view in the era of large-scale information flow, as well as to have communication skills. Based on this, a person can overcome any misunderstandings and difficulties through cultural experience in the process of establishing a relationship with a representative of another culture. Cultural awareness and communication skills ensure successful interpersonal dialogue [4]. As a rule, learning and mastering the differences between cultures takes place in foreign language classes. Based on this, it can

be said that sociocultural competence is a component that plays a major role in human development.

That is, the importance of formation of sociocultural competence was directly related to the growing trend of learning any foreign language and the intermingling of different world cultures. The presence of sociocultural competence in a person and the components that are the basis for its formation have been intensively studied in recent decades. In addition to foreign researchers, this article will discuss the work of scientists who studied this competence in coordination with the needs of the education system of Kazakhstan.

Literature review

During the analysis of social and cultural competence on a theoretical and methodological basis, it is necessary to consider the origin of this competence. The American linguist N. Chomsky reintroduced the concept of competence in teaching a foreign language into the circulation of science [5]. In his studying, the concept of competence is described as consisting of a set of abilities aimed at the implementation of linguistic activity.

Over time, the content of the concept of competence increased, and the components or sub-competencies that are part of it began to be studied individually. Among them, its communicative competence within the framework of language competence was mentioned for the first time in the work of the American sociolinguist D. Hymes [6]. According to his description, cognitive and social factors interact in knowing and using a foreign language within the framework of communicative competence.

It has become known that this communicative competence, which has not lost its relevance, but is considered the main prerequisite for learning a foreign language, cannot guarantee the success of intercultural

mutual dialogue [1]. Here, in teaching a foreign language, there is a problem of teaching communication, taking into account the social factors and cultural features of that language.

In teaching a foreign language, Safonova [7], Sysoev [8], Galskova [9], Elizarova [10] considered the sociocultural concept as a component of communicative competence and formulated its content using its main components. Safonova [7] says that for the formation of sociocultural competence in an individual, it is necessary to learn different civilizations and norms of communication, some special facts, while developing his personal qualities, knowledge and skills, to rely on these guidelines in intercultural communication.

In addition, according to the research of Sysoev [11], the content of socio-cultural competence consists of a set of national and spiritual values, national mentality, communication and traditional features of the language culture being learned.

According to Efremova [12], sociocultural competence of students consists of the sum of their knowledge about their own culture and the culture of the language they are learning, and it is considered as one component of communicative competence. On this basis, communicating skills are formed in the student depending on the relationship situation, and he is taught to adapt his behavior depending on the environment.

Furthermore, in the research of Kunanbayeva [13], who contributed to the development of domestic science, sociocultural competence is a prerequisite for understanding between two cultures when establishing a relationship with a representative of another culture. Therefore, mastering a foreign language only as a means of communication cannot be the key to successful communication [13]. In this regard, in the process of teaching a foreign language, teaching the semantic content of that country's culture was given the main attention. Because the greater the difference between languages and cultures, the more difficult it is to communicate and establish a dialogue with representatives of those languages.

Then it can be summarized that sociocultural competence is a person's knowledge in the social and cultural sphere and the ability to establish relations with other cultures, the ability to use the integrative process correctly.

The importance of sociocultural competence in the society of Kazakhstan is caused by raising the level of domestic education to a new innovative level, based on international education models, within the framework of the country's transition to a trilingual education system [14].

The importance of this problem is not only in Kazakhstan, in fact, in many educational systems of the world, the development of students' ability to establish intercultural relations, teaching to maintain tolerance, or the formation of general personality traits have not yet been fully addressed [12]. Therefore, here the teacher's role in the development of sociocultural competence prevails.

For many years in Kazakhstan, foreign language educational materials and curricula have been prepared in accordance with the content of general education. At

that moment, it was necessary to prepare educational requirements and tasks according to competence-based context. In particular, in accordance with the requirements of the Law on Education, it was required to create a sociocultural component in foreign language materials in order to train future teachers, compile textbooks, and to form competence in teaching students [15].

In addition, many foreign language specialists of Kazakhstan did not fully understand the importance and meaning of this competence. For that reason, they did not create a specific plan for the formation of sociocultural competence. As a result, the formation of this competence in the educational system was developing differently in all educational institutions.

Another reason for such disparity is that teachers' lack of special professional knowledge or sociocultural experience aimed at competence has a negative impact on the educational process. In this regard, in recent years, the criteria determining the formation and development of sociocultural competence in a foreign language teacher [16] have been studied and conducted a special examination with the research of pedagogic and methodical specialists of Kazakhstan. In their study, the social and cultural competence of a foreign language teacher consists of an integrated complex of knowledge that forms their social and cultural knowledge and skills, abilities, and personal qualities. Based on these characteristics, the authors [16] divided the criteria for the formation of sociocultural competence into the following groups: cognitive (the culture, traditions, geography, history of the language being studied, the sociocultural content of words, the behavior of representatives of that language norms, etc.), operational and technological (skills to search, analyze and use social and cultural information), personal (showing tolerance and empathy for another culture, learning its peculiarities, etc.).

Foreign language teachers with the above-mentioned criteria can assess their students' sociocultural competence at a special level to determine whether it has been formed and developed [17].

Although the directions of the foreign language learning process are gradually changing towards the formation of sociocultural competence, there are still teachers who do not include this competence in the curriculum. Its reasons can be different in addition to the factors mentioned above. Therefore, the relevance of this article lies here. In order to determine the causes of this problem, the following research questions are asked:

1 What are the teachers' perceptions of forming sociocultural competence in secondary school students?

2 Do teachers include sociocultural competence as an important skill in the teaching process?

3 What kind of tools and approaches do teachers use to form sociocultural competence of students?

Methods

1 Research design

This research paper was carried out at Kazakh Ablai Khan University of International Relations and

World Languages at the Department of Foreign language education Methodology. The data were collected through a questionnaire, which analyzed and determined the level of understanding and application of sociocultural competence of foreign language teachers teaching in secondary schools. The study of the factors influencing the perception of English language teachers, using questionnaire questions, revealed the main key feature that affects the formation of the sociocultural competence of their students.

2 Participants

This study involved 21 teachers working in various types of schools in Almaty. The teachers who participated in the survey varied in age, university education, work experience, as well as the teaching requirements and teaching materials of the school where they work, and the classroom environment and the number of students in their class. In this regard, when formulating the survey questions, various aspects of determining their professional knowledge and sociocultural competence were taken into account.

Table 1

Participants (teachers') profile				
Gender	Degree	Experience	School	Class
Female – 19 (90,5%)	Undergraduate – 4 (19%)	1-1,5 years – 5	Private school – 4 (19%)	5-7 th grades – 8 (38,1%)
Male – 2 (9,5%)	Associate degree – 1 (4,8%)	2-4 years – 13	State school – 8 (38,1%)	8-9 th grades – 5 (23,8%)
Prefer not to say – 0	Master's – 15 (71,4%)	5-9 years – 3	Language school – 8 (38,1%)	Only primary school – 6 (28,6%)
	Doctorate – 1 (4,8%)	10 and more – 0	Private tutor – 1 (4,8%)	Only high school – 2 (9,5%)

As it is illustrated in table 1, most of the teachers' gender is female and most of the respondents have master's degrees. More than half of the participants have 2-4 years of work experience, which means that many of them have already been aware of new requirements of the education system, where they must be acquainted with competence-based learning.

3 Instruments

The researcher formulated survey questions in English, in which answers were received in English, and. The survey was conducted in the form of a Likert scale of 5 response options: from strongly disagree to strongly agree. In addition to answering questions based on close-ended questions, the questionnaire method used multiple-choice questions, as well as open-ended questions was utilized in order to gather a more detailed answer from the participants' point of view. During the analysis of the answers to the questionnaire, the degree and work experience of teachers in different categories were taken into account. In addition, the survey was piloted to preserve the anonymity of the teachers and to ensure reliability and validity.

4 Research procedure

Before conducting the research, the author of the article reviewed the relevant literature revealing the relevance of the topic, and based on the previous research works, she designed a questionnaire according to the relevance of the article and checked the reliability of the research tool. Taking into account the requirements, after ensuring the originality of the work, the survey questions were conducted online in the Google Form

format. Names, jobs and degrees of teachers participating in the survey were kept confidential. After the survey responses were collected, the data was analyzed. On the basis of that, the study of the main factors that influenced the different perception of sociocultural competence and its use by English language teachers was discussed.

Results

This research work conducted a questionnaire about teachers' awareness and attitude towards implementing sociocultural competence in English classrooms. The responses were analyzed by the author of this academic paper, and it helped the researcher to have an overview of teachers' perception and understanding of sociocultural competence, particularly, their attitude in the formation of sociocultural competence among secondary school students in English language classrooms.

Research question 1

The research question 1 was formed to identify teachers' perceptions of forming sociocultural competence in secondary school students. As Figure 1 shows, the majority of the respondents (57,1%) agree with the statements that according to the requirements of the Education system of Kazakhstan, the English language curriculum should be created on the basis of a competency-based approach. This implies the teachers' positive perception of forming a competence. In addition, according to the results, 14,3% of teachers strongly agree with the competence-based approach in teaching. Only a few of them showed their negative attitude, while 5 of the participants kept neutrality.

1. According to the requirements of the Education system of Kazakhstan, the English language curriculum should be created on the basis of a competency-based approach?

21 responses

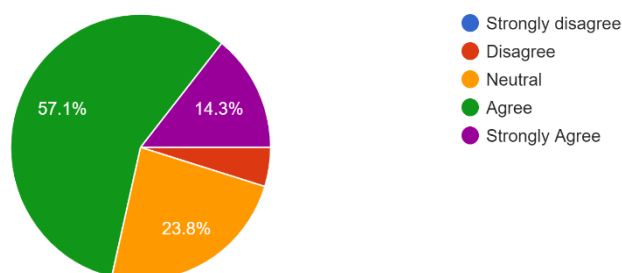


Figure 1. According to the requirements of the Education system of Kazakhstan, the English language curriculum should be created on the basis of a competency-based approach

As it is indicated in Table 2, the teachers' attitude towards sociocultural competence was analyzed in order to reveal participants' clear picture about the essence of this competence and suitable environment for its forming.

Table 2

Teachers' attitude towards sociocultural competence

№	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Due to the integration of world cultures and languages in the modern world, sociocultural competence has become one of the most important competences that must be formed in a person?	0	1 (4,8%)	4 (19%)	12(57,1%)	4 (19%)
The English class is the only environment in which a person's sociocultural competence is developed because learning English allows us to become familiar with the cultures of the English-speaking community.	0	3(14,3%)	6(28,6%)	38(38,1%)	4 (19%)

Both Figure 1 and Table 2 demonstrates the positive attitude of English language educators towards the use of sociocultural competence in practice.

Research question 2

The aim of the research question 2 was to discover teachers' readiness to include sociocultural competence

as an important skill in the teaching process of foreign language (Figure 2). Based on the responses for this question, if teachers incorporate sociocultural in their classroom, what skills do they develop in their students?

4. If you know the importance of sociocultural competence, do you include it in your lesson plan to develop it in your students?

21 responses

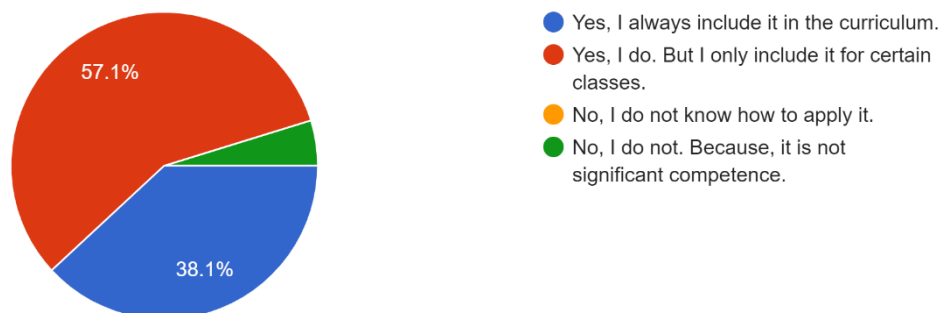


Figure 2. If you know the importance of sociocultural competence, do you include it in your lesson plan to develop it in your students?

5. If you incorporate sociocultural competence into your practice, what skills will it develop in your students?

21 responses

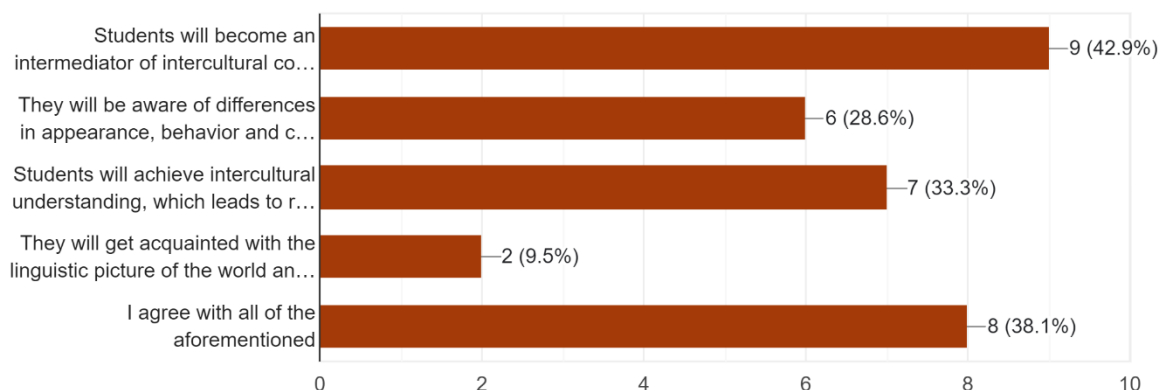


Figure 3. If you incorporate sociocultural competence into your practice, what skills will it develop in your students?

6. If you have not implemented sociocultural competence in your classroom yet or if you have difficulties in applying it, then what is the reason?

21 responses

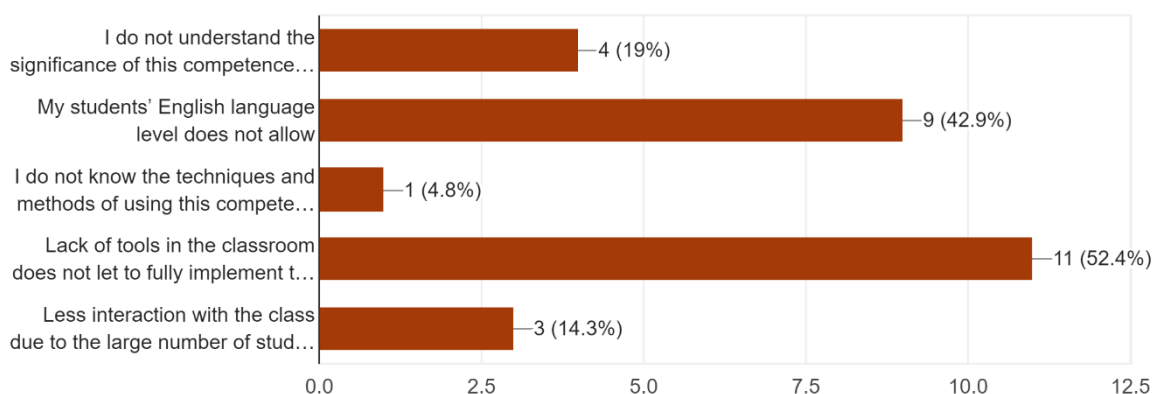


Figure 4. If you have not implemented sociocultural competence in your classroom yet or if you have difficulties in applying it, then what is the reason?

Figure 3 provides us with the information about the skills of students which will be formed with the help of sociocultural competence in the English language classroom. 42,9% of respondents teach their students to become an intermediary of intercultural communication. Only 2 people think that to get acquainted with the linguistic picture of the world and acceptable speech practices are main skills. Other participants think that achieving intercultural mutual understanding and being aware of differences in appearance, behavior and cultural identity are significant skills that students should develop. Moreover, figure 4 shows the obstacles in implementing sociocultural competence in the English language classroom. Majority of teachers think that

lack of tools in the classroom does not let them fully implement this competence, while others think that students' English language level does not allow them to apply sociocultural competence.

Research question 3

The aim of the 3rd research question was to identify the most effective tools or techniques to develop sociocultural competence in the English language classroom. As Figure 5 demonstrates, many respondents chose gamification, role-playing or theatrical games, because of their interaction and communication-based approach. More efficient types of tool for second groups of teachers are multimedia, ICT technologies, audio-visual tools.

7. Which of the technologies listed below, in your opinion, will be more effective for the development of sociocultural competence of secondary school students?

21 responses

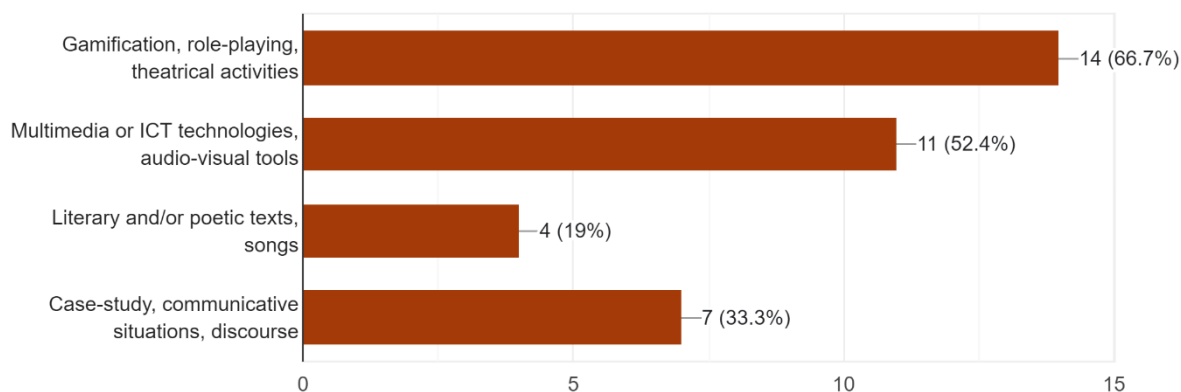


Figure 5. Which of the technologies listed below, in your opinion, will be more effective for the development of sociocultural competence of students?

Discussion

The primary purpose of this research was to study the teachers' perception of sociocultural competence in English classes in secondary schools. Prior studies showed that despite the existence of a professional knowledge base of teachers, in practice, their failure to consider the relevance of sociocultural competence and the importance of including it in the class plan as one of the problems that must be solved in the current education system hinders the development of students' communication [15].

However, the fact that teachers, discovering the meaning and importance of sociocultural competence, begin to consider this competence as one of the skills that should be found in a modern person, shows that their attitude towards this competence is positive. As stated in the literature review, when English language teachers possess all of the three criteria of sociocultural competence characteristics [16], they can understand the significance of this competence and can apply it in their classroom. As in the current modern education system, the requirements for the curriculum in foreign language classes of all schools are the same [18], then the findings of this research reinforced this study conducted by Kim and Amirova [16], where English language teachers' implement sociocultural competence into their secondary school classes, as well as they apply specific modes of techniques in order to develop this competence on students. Therefore, based on Figure 4, the results of the research show that more than half of the teachers, who participated in the questionnaire, use this competence only in certain classes. However, there still exist common issues on implementing sociocultural competence properly. As indicated before, lack of tools in the classroom and students' English language level interferes with the lesson. Since most of the respondents here are young professionals and the finding of the research cannot be a common statistic for all Kazakhstani schools.

Another reason for implementing sociocultural competence is that this competence allows learners to

adapt in various kinds of cultures and those communicative norms of interaction, phenomena and cultural identity [19]. Apparently, there is a need for young English language educators with advanced thinking capable and sociocultural condition of professional activity [20], who teach and direct their students to develop this competence using approaches and techniques. The findings suggested that activity-based techniques are more effective tools to apply sociocultural competence; a significant number of secondary school teachers utilize gamification, role-playing and theatrical games in their classroom. Since other tools such as multimedia or ICT technologies, literary texts or songs are less important, which may explain the non-interactive method used in the formation of sociocultural competence of secondary school students. It can therefore be assumed that the teachers' awareness of sociocultural competence and its significance leads them to establish a sociocultural competence-based environment in the classroom is useful for maintaining secondary school students' positive attitudes, which will affect the improvement of their competence.

Conclusion

The findings reveal teachers' perception of forming sociocultural competence among secondary school students in English classes. Analysis of theoretical sources set up sociocultural competence as one of the significant competences of the modern world, which led a person to own necessary skills and qualities that will be useful in the communication with other cultures. This study points out both teachers' positive and negative outlook on utilizing sociocultural competence for secondary school students in English classrooms. This shows that developing sociocultural competence of students in the English language will establish a certain intercultural understanding.

This research work found out that regardless of having various professional backgrounds, teachers could not equally apply sociocultural competence in all classes, because of some reasons. It is mainly due to the classroom environment and students' English language

level. In addition, analysis of survey questions lets researcher identify the tools and techniques that will be used to apply sociocultural competence. However, due to the time limitation, the survey covered only a small number of teachers, which can not reveal the attitude and perceptions of all educators towards sociocultural competence in Kazakhstan. The recommendations for further research would be: a) to identify the most effective tool for forming sociocultural competence of secondary school children; on this basis b) to conduct an experiment to verify the usefulness of this technology in forming sociocultural competence of students.

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Koryahin V.,*Lviv Polytechnic National University, Ukraine***Hrebinka H.,***Lviv Polytechnic National University, Ukraine***Serbo Ye.,***Lviv Polytechnic National University, Ukraine***Tykhii I.,***Lviv Polytechnic National University, Ukraine***Kozak I.,***Lviv Polytechnic National University, Ukraine***Borovyk Yu.***Lviv Polytechnic National University, Ukraine*<https://doi.org/10.5281/zenodo.7525694>**Abstract**

The issue of ensuring competitive activities' efficiency of basketball players has been considered. It has been established that the basis of this process lies in the choice of the most efficient means and methods of training based on physiological functions control data. The purpose of the study was to assess the basketball players' activity during the competitions and to establish changes in the players' physiological functions during training and competitions. For the experiment, highly qualified athletes – international tournaments participants – were examined.

According to the pedagogical assessment of the physiological features of basketball players activities during the competitions, changes in the players' physiological functions during training and competitions have been found out. It has been established that physiological changes in basketball players' bodies depend on the nature of the play activity and the protection system. The level of oxygen consumption during the game varies from 72.3 to 96.6% of the maximum oxygen consumption with an average of 85.8%. According to the results of the experiment it became clear that the functions of various organs and systems of basketball players develop during the competitions. Therefore, it is necessary to pay great attention to development of both aerobic and anaerobic qualities of athletes in the course of training, in particular of anaerobic glycolytic the speed endurance depends on. The change of protection systems during the game significantly influences aerobic and anaerobic metabolism indicators. The presented empirical results of the research carried out allow us to conclude that the energy supply of sports competitions in basketball is aerobic-anaerobic in nature with high proportion of glycolysis. In general, physiological changes in basketball players' bodies depend on the nature of the play activity and the protection system.

Keywords: *basketball, competitive activities, training, physiological changes.*

INTRODUCTION

The choice of the most efficient means and methods of training aimed at increasing the functionality of athletes is based on knowledge of the requirements to the body set by certain sports [1,2]. The question of establishing criteria for certain functions and physical features of athletes [3,4,5] still needs to be studied.

MATERIALS AND METHODS We strived to assess the physiological features of basketball players' activities during the competitions and find out changes in the players' physiological functions during training and competitions. We examined highly qualified athletes – international tournaments participants. The players' activity among men's teams was evaluated using timing. The duration of the active and passive phases of the game was recorded. The active phase – from the moment the player touches the ball on the site and until the ball has gone out of bounds, and the passive phase – since stopping the stopwatch which counted the period of the active phase until the ball is returned into the game. At the same time, the content of these phases and reasons for stopping the game have

been analyzed. The games were timed during the experiment.

The volume of shifts in the bodies of basketball players was being detected in various ways. Thus, the heart rate (HR) was recorded by four-channel system «Sport» and one-channel system «Nec-spurt». In parallel, samples were taken using the Douglas-Holden method to determine the volume of oxygen consumption and oxygen debt in the course of work [6].

The results of the game timing during the national championship and in international basketball tournaments are shown in Table 1.

RESULTS AND THEIR DISCUSSIONS

Consequently, basketball players are in very tense condition during the game for quite a long time. According to our observations, the game lasts for 69 minutes 27.7 seconds on average, not taking the breaks between the two halves into account. Other authors recorded values close to our results (65 min 53.6 sec) [7,8,9,10]. Average duration of the first half is 34 min 20.6 sec, of the second half – 35 min.7.1 sec.

Table 1

Results of the games timing in international basketball tournaments (p=50)

Indices	First half	Second half	Total for the game
Total number of active phases during the game	45.5 ¹ ±1.25 ² 6.5 ³	43.5±1.34 7.0	89.0±1.34 7.0
Total number of passive phases during the game	44.5 ¹ ±1.25 ² 6.5 ³	42.5±1.34 7.0	89.0±1.34 7.0
Average duration of the active phase of the game, sec	26.9±0.77 4.02	28.4±0.84 4.37	27.7±0.84 4.37
Average duration of the passive phase of the game, sec	19.3±0.55 2.87	21.5±0.7 3.65	20.4±0.7 3.65
Game total duration	34 min 20.6 sec	35 min 7.1 sec	69 min 27.7 sec
Fraction of "net" playing time in the total duration	58.3	57.0	57.5

Note: the numbers given in the table mean: ¹ average, ² standard error of average, ³ standard deviation.

The active phase lasts on average for 27.7 sec. The periods of active activity are repeated after every 20.4 seconds of the passive phase. In the course of the game with ball running out, with technical errors, playing out a jump ball, personal remarks, for which foul shot are not assigned, the passive phase lasts, as a rule, 2–10 seconds. Provided minute breaks, performance of foul shots and replacements its duration increases to 0.5–2.5 min.

As for the indices of the average number of active and passive phases of the game, certain differences have been identified ($P < 0.01$). The same applies to average duration of the active and passive phases of the game between the first and second parts. Longer duration of the passive phase in the second half, apparently, is partly due to the fact that as a result of athletes' increased fatigue 35.7% of the fouls received by the team are hit here, and only 25.7% in the first half of the game.

The time structure of the game somehow indicates the nature of the energy supply of basketball players

during the work. During the gaming activity period lasting for about 30 seconds, the aerobic process fails to reach its maximum power, while the anaerobic one is meanwhile being exhausted in the working muscles [11,12]. The most important role in the energy supply of the exercise at such time intervals is played by anaerobic glycolytic process [13,5]. However, since active pauses with significant reference to glycolysis are multiply repeated (89 times per game) through relatively short (20 sec) rest intervals, then during the game the conditions for aerobic process reference are also created. It may be assumed that the energy supply of basketball players during the game will have a mixed aerobic-anaerobic character with high specific gravity of glycolytic reactions.

The direct answer to the question of which functions are most often used in the course of game can only be obtained by direct recording of the volume and nature of physiological changes in the bodies of basketball players during the matches (Table 2).

Table 2

Results of study of the training and competitive games influence on the bodies of basketball players (p=50)

Indices	Game time ¹	Range of variability
Total time of participation in the game, Min.	18.59 27.98	3.5 -38.16 4.9-68.10
Maximum heart rate during the game, bpm	198,9	180-230
Average heart rate during the game, bpm	114,0	90.5-147.6
Maximum pulse sum, bpm	2346,7	637-4450
Maximum recovery sum, bpm	3396.9	1991-4059
O ₂ -consumption level, l/min	85.8	72.3-96.6
O ₂ -consumption, % from the maximal index	3.25	28.7-3.78
Total O ₂ – debt, l	5.87	4.49-7.9
CO ₂ -emission level, l/min	2.9	2.53-3.4
Pulmonary ventilation level, l/min	79.5	59.5-105.1
Oxygen pulse, ml per beat	17.0	15.0-19.9

¹"Net" time of participation in the game in the numerator and total time of the game in the denominator.

It has been found out that basketball players spend a lot of energy during the game. The level of oxygen consumption during the game varies from 72.3 to 96.6% of the maximum oxygen consumption with an average value of 85.8%.

Significant activation of aerobic changes in the exercised muscles is evidenced by high level (2.51l/min)

of alactic O₂-consumption. Indicators of lactic O₂ consumption are also moderately high (0.42 l/min.), which shows the degree of myocardium metabolic activity. Significant activation of cardiac activity is confirmed by the maximum heart rate – 198.9 bpm on average within the range from 180 to 230 bpm.

Participation in a tense game along with significant activation of aerobic functions leads to considerable use of anaerobic energy sources. This, in particular, is confirmed by the value of O_2 -debt, which reaches 4.5-7.9 liters at the end of the game. The corresponding value of heart rate insufficiency in these conditions varies from 1991 to 4058 bpm. «Excess» of carbon dioxide reaches 1.32 l/min.

The change in protection systems in the course of game is significantly reflected in the indicators of aerobic and anaerobic metabolism. Most often this is observed at the application of «pressing» protection system. Changes in physiological parameters of basketball players of different roles after 19 minutes of game are shown in Fig. 1. The oxygen and heart rate debt of the player, who played the role of the attacker, changes the most. The level of O_2 -consumption did not change significantly during the game.

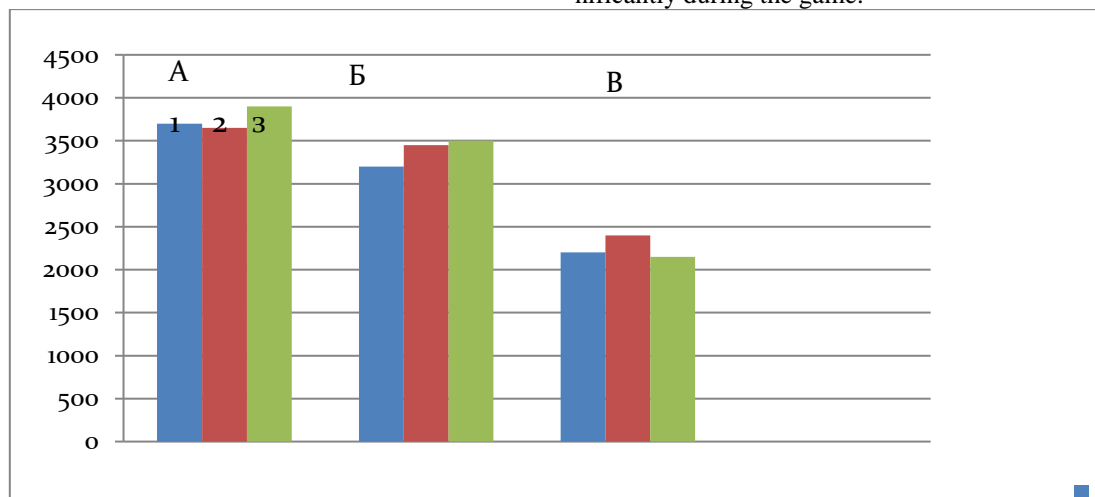


Figure 1. The values of the heart rate (A), oxygen (B) debt and the level of O_2 -consumption (C) in 1st class basketball players: 1 – data of central player; 2 – defender; 3 – attacker

Interpretation of the received data about the changes in the players' physiological functions in the process of training and competition makes it possible to better understand them. The result obtained during the pedagogical control of the physiological features of basketball players was consistent with the information [14,8,10,15], that basketball players spend a lot of energy during the game.

The experiment analysis showed that the functions of various organs and systems of basketball players develop during the competitions. Therewith, we state it is necessary to pay great attention to development of both aerobic and anaerobic qualities of athletes in the course of training, in particular of anaerobic glycolytic the speed endurance depends on. It is as well necessary to develop aerobic capacity because the efficiency of the gaming activities implementation in oxygen supply of the body is somewhat affected by the recovery rate of energy processes' disturbed balance, and this property is determined by the level of development of players' aerobic capabilities. This confirms the information available in the literature [16,5,17,18].

We reconcile our results [1,9,19] that defenders and attackers move more during the game than the center players. However, the center players are actively involved in the fight for the ball under the shield. Therefore, the load on the body of basketball players of various game functions is approximately the same players with different roles have the same requirements for functional training [3,2,15,20].

The results of the study supplement the information on the pedagogical control of competitive and training activities of basketball players regulating the

expediency of pedagogical influences to ensure the efficiency of the basketball players' competitive activities [2,6,14].

CONCLUSIONS

Thus, the energy supply of basketball sporting events is of aerobic-anaerobic nature with high specific gravity of glycolysis. Physiological changes in basketball players' bodies depend on the nature of the play activity and the protection system. The «pressing» system is accompanied by considerably greater strain than personal and zone protection systems.

The authors of this study confirm that the research and publication of the results were not associated with any conflicts regarding commercial or financial relations, relations with organizations and/or individuals who may have been related to the study, and interrelations of co authors of the article.

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PHYSICAL SCIENCES

WHY IS THE INCORRECT VERSION OF SPECIAL RELATIVITY STILL BEING STUDIED IN PHYSICS TEXTBOOKS, WHICH DENIES OHM'S LAW FOR ALTERNATING CURRENT USED WORLDWIDE BY MILLIONS OF RADIO AND ELECTRICAL ENGINEERS?¹

Antonov A.

PhD, HonDSc, HonDL, ResProf., H.ProfSci

Independent researcher, Kiev, Ukraine

<https://doi.org/10.5281/zenodo.7525751>

Abstract

The article states that the existing version of the special theory of relativity (STR) is incorrect, since relativistic formulas obtained therein are incorrect; they have been incorrectly explained by using the incorrect principle of speed of light non-exceedance and entailed wrong conclusions about physical unreality of imaginary numbers and existence of only our visible universe. It mentions experimental evidence of the foregoing, obtained by the author within study of transient and resonant processes in linear electric circuits. It is shown that the existing version of the STR implies conclusions on nonexistence of tsunami and bell ringing, piano music and swinging children's swings, as well as many other real processes. It is also shown that the existing version of the STR denies even the possibility of existence of radio- and electrical engineering. Therefore, it is concluded that existing university physics textbooks should be corrected.

Keywords: *Special theory of relativity, physical reality of imaginary numbers, theory of linear electrical circuits, radio engineering, electrical engineering.*

1. Introduction

The special theory of relativity is now presented for study in all university physics textbooks and its creation by Joseph Larmor [1], Nobel Prize winner Hendrik Anton Lorenz [2], Jules Henri Poincaré [3], Nobel Prize winner Albert Einstein [4] and other prominent scientists is rightfully considered the greatest achievement of physics of the 20th century. However, its creation stopped halfway due to the lack of necessary experimental knowledge at that time and the inability of its authors to correctly explain the relativistic formulas obtained in STR. They did not know how to explain that according to these formulas all the results of calculations at superluminal velocities turned out to be imaginary numbers discovered by Scipione del Ferro, Niccolò Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli [5] 400 years ago. It is also possible that Paolo Valmes [6] was even first to make the scientific discovery, for which he was burned by the sentence of Spanish inquisitor Thomas de Torquemada. But it was necessary to explain these formulas, because a theory that even its authors could not explain would be of no use to anyone. Therefore, a postulate called the principle of light speed non-exceedance was introduced into the STR. The postulate implied that a situation at superluminal velocities might be unexplained, as people would never face it. Consequently, a belief that imaginary numbers were physically unreal turned out to be possible. Thus, relativistic formulas appeared to be explainable.

It was convenient, but unproven and, as it turned out later, incorrect. But in this form, the generally accepted version of the STR was studied in all university physics textbooks. And it is still studied today.

However, this postulate was refuted by the discovery of Cherenkov radiation [7], for which Pavel Alekseyevich Cherenkov, Igor Evgenyevich Tamm and Ilya Mikhailovich Frank received the Nobel Prize in 1958. And at that time the generally accepted version of STR was saved by specification that the principle of non-exceeding the speed of light refers to the speed of light only in a vacuum. But by numerous experiments [8]-[23] performed in the 21st century it was proved that such corrected formulation of the principle of non-exceeding the speed of light is also incorrect. As it turned out, this formulation was refuted by the existence of natural phenomena known from time immemorial - tsunami, bell ringing, music created by pianos and even swinging after pushing by parents children swings, which the authors of STR at its creation did not take into account. This formulation was also refuted by the existence of radio- and electrical engineering.

As a result by all these experiments and the mentioned natural phenomena a very important general scientific principle of physical reality of imaginary (and consequently also complex and hyper-complex) numbers by which the really existing huge and still completely unknown to the modern science world is described was proved. And the use of the principle of physical reality of imaginary numbers as applied to the universally accepted version of STR allowed us to con-

¹ This is reprint of the article "Antonov A. A. "Why the physics textbooks teach an incorrect version of the special theory of relativity which denies the existence of radio- and electrical engineering". Challenges and problems of modern science. Proceedings of the III International Scientific and Practical Conference. London, United Kingdom. 2022. pp. 78-86. <https://conference-w.com/>

clude that the relativistic formulas obtained in this version are wrong in general, because at hyperluminal speeds they correspond to an unstable, i.e. instantly self-destructive, physical world.

What is the most surprising is that, despite all the aforementioned sensational experimental refutations² [24]-[44], the incorrect version of the STR has still been groundlessly believed to be correct and studied in all university physics textbooks, as well as naturally used by physicists in their fruitless scientific research - for example, in attempts to understand what is dark matter and dark energy while performing research at the Large Hadron Collider. It is completely unclear why a single disproving experiment is enough to refute other hypotheses and theories in physics and other sciences, whereas the existing version of the STR turned out to be irrefutable despite all the experimental and theoretical proofs of its falsity. Moreover, in the USSR even three times in 1934, in 1942 and in 1964 by the decisions of the Central Committee of the All-Union Communist Party (Bolsheviks) and the Presidium of the Academy of Sciences of the USSR, which have not yet been canceled, it was generally forbidden to criticize this theory. That's why the question raised in the article title is very important and ways and rates of further science development would depend on answer thereto.

Further, we will try to answer this question.

2. From STR it follows that radio engineering and electrical engineering should not exist in nature

And we will make this attempt on the example of one more refutation of the generally accepted version of STR. On the assertion that STR on the one hand and radio engineering (and electrical engineering too) on the other hand mutually refute each other [45]-[54]. But since there can be no doubt about the existence of radio engineering and electrical engineering, it is obvious that then the existing interpretation of SRT is incorrect.

But do the STR and radio engineering actually refute each other? Let's check it out. Let's look at the arguments of SRT. It follows from the fundamental principle of the STR on light speed non-exceedance that imaginary numbers³ have no real physical content. In other words, objects and phenomena described using imaginary numbers do not exist. This expressly follows from the version of the STR set forth in all university physics textbooks. And neither authors of the textbooks nor anyone else can still explain what, for example, 5i meters, 200i grams or 300i meters, where $i = \sqrt{-1}$ is, whereas everyone knows what 5 meters, 200 grams or 300 meters is. That's why the principle of light speed non-exceedance used in the STR has caused no objections.

However back in 1893 Charles Proteus Steinmetz (original name Karl August Rudolf Steinmetz) offered, as applied to linear AC circuits, his interpretation⁴ of Ohm's law, discovered by Ohm in 1826 as applied to DC circuits. According to his theory, called a linear circuit symbolic analysis method, not only resistors, but also capacitors and inductors have resistance referred to in Ohm's law. Herewith, resistance of resistors R is measured by real numbers, and resistance of capacitors C and inductors L is measured by imaginary numbers $j\omega L$ and $-j/\omega C$, where $j = \sqrt{-1}$ is the so-called imaginary unit⁵, and ω is the frequency of applied voltage. But in accordance with the principle of light speed non-exceedance their resistances do not actually exist, just as on the same basis in accordance with the STR there are no relativistic mass, time and length at superluminal velocities. They are even called imaginary resistances in the theory of electric circuits.

Consequently, real electrical resistance of any LCR - circuit must always be determined only by resistors R included in this circuit and be measured by real numbers. Therefore, the current flowing through such an electrical circuit should not depend on the value of the frequency of the applied voltage. This means that there could be no resonance in such electric circuits, and electrical filters could not be created. For this reason, existence of radio engineering and electrical engineering is also completely impossible.

3. However, it follows from the existence of radio engineering and electrical engineering that the version of SRT studied in all physics textbooks is incorrect

Now, let us come to think of it.

There is no doubt that nature is one and the laws of nature are also one. Always and everywhere. Be it on Earth, or in the depth of space, or in the microcosm, or in animate or in inanimate nature. However, people, due to their limited intellectual capacity, are able to absorb only a very small part of this knowledge. Norbert Wiener wrote in this regard: "Important researches sometimes delayed by the unavailability in one field of results that may have already become classical in the next field"

That was what happened in physics in the 20th century.

Physical reality of imaginary numbers unknown in physics to this day had been known in radio engineering even before the STR was created. Moreover, there are other sciences that use imaginary numbers besides physics. Unlike physics that has still had no idea of physical interpretation of relativistic formulas of the STR at superluminal velocities (therefore, the principle of light speed non-exceedance proved to be in demand

² Which, in contrast to the widely publicized unsuccessful OPERA experiment, were quite reliable and, having been done before the OPERA experiment, made it unnecessary

³ Naturally, it makes sense to talk about the physical reality of imaginary numbers, as well as real numbers, only in relation to named numbers, equipped with indications of the units used for the corresponding parameters of physical objects and processes.

⁴ On which he made a presentation at the International Electrical Congress and, in addition, in the proceedings of the American Institute of Electrical Engineers published an article "Complex quantities and their use in electrical engineering."

⁵ In the theory of electric circuits the imaginary unit is commonly denoted by the letter j , whereas the letter i denotes electric current.

in the STR), radio engineering textbooks perfectly explain the use of imaginary numbers.

In 1826, when there had been no electrical measuring equipment, Georg Simon Ohm discovered a law applicable to DC circuits. The law was named after him [55], [56]. And in 1893 Charles Proteus Steinmetz proposed his interpretation of Ohm's law in respect to linear AC circuits [57],

Now millions of engineers all over the world use it daily in their practice. According to the symbolic electric circuit analysis method proposed by him, resistance of any LCR-circuit would be measured by complex numbers whose values depend on frequency of voltage applied to an electric circuit.

This makes it possible to carry out a very simple and comprehensible experiment that answers the question whether imaginary numbers are physically real. And all we need for this is to change the frequency ap-

plied to a considered LCR-circuit and once again measure the value of current flowing in it. If the value of current does not change, resistances of capacitors and inductors included in the circuit are actually imaginary by its physical nature. And if the value of current changes, then these resistances are imaginary only in name and since they are measurable, they are actually existent. After all, most of what we know about the world around us, we have learned in physics, biology, chemistry and all other sciences particularly with the help of measuring devices. And if we learnt about the world around us directly with the help of our senses and trusted only them, there would be no science.

All engineers who have ever held a soldering iron in their hands know that resistance of LCR-circuits always depends on frequency of voltage applied to them. This dependence is called the frequency response. For many decades, the industry has even mass-produced devices for measuring frequency responses (see fig.1).

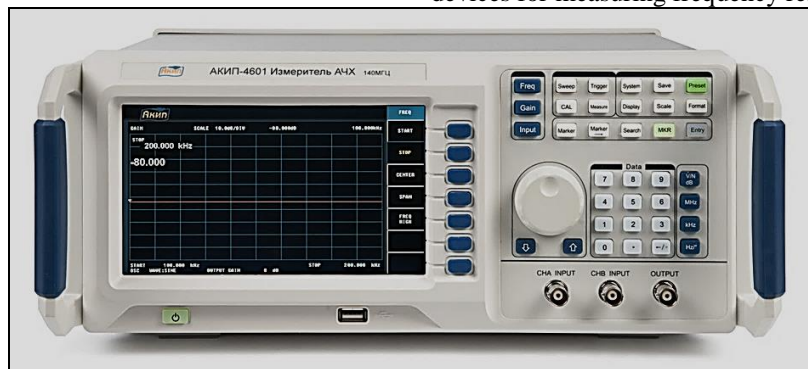


Fig. 1. In any radio engineering laboratory there are devices (one of them is shown in the figure), called frequency response meters, which by their very existence prove the physical reality of imaginary numbers. Thus they prove the incorrectness of the existing version of SRT, and the OPERA and ICARUS experiments at the Large Hadron Collider made it unnecessary

Thus, radio engineering undoubtedly proves physical reality of imaginary numbers and thereby refutes the principle of light speed non-exceedance, and, consequently, the version of the STR presented in all university textbooks of physics.

4. Why did the existing version of STR turn out to be irrefutable?

Despite all the refutations mentioned above, the version of the STR set forth in modern textbooks continues to dominate in physics and is studied even in the most prestigious universities. And involuntarily the question "why?" arises. Why is it that in other sciences one experiment that refutes them is enough for the corresponding hypothesis or theory to cease to exist? And in physics, SRT, in spite of everything, turned out to be irrefutable. Why did the existing version of STR turn out to be irrefutable?

The answer to this question is obvious - because this version of SRT is in demand. But this answer raises another question - by whom and why is it in demand? And the answer to it is also simple - by relativistic physicists and for career reasons. But it's not entirely obvious.

Then let us remember. At the beginning of the 20th century, the STR was met with hostility. Nobody understood and accepted it, since scientists had previ-

ously carried out their research based on classical physics, which even now is much more requested than relativistic physics. However, the STR overcame general scepticism of physics community and began to be studied in textbooks. Now history repeats itself. For more than 100 years of its existence, many studies have been done, many theses have been defended, many articles and books have been published, and many physicists have created their careers on the basis of the STR. Many physicists-relativists have headed academic departments and journal editorial offices. Considering that there is no antimonopoly law in science, but rather competition, physicists have naturally begun to use their position to stifle scientific dissent. Sir Karl Raimund Popper [58] wrote: "... *Struggle of opinions in scientific theories is inevitable and is a necessary prerequisite for the development of science.*"

Therefore, in order to answer the question posed in the title of the article, it is necessary to take into account the psychological aspect of the problem of competition in science, which is actually a kind of business. Hans Christian Andersen's fairy tale "The Emperor's New Clothes" perfectly illustrates the paradoxical nature of the solution of this problem in STR. It is clear from the tale that the indisputability of the existing version of the (essentially incorrect) STR was achieved by taking the problem of its existence beyond the bounds

of common sense. The same way in Andersen's fairy tale, in which knavish tailors suggested to the king that he make clothes invisible to the unwise courtiers and visible to the wise courtiers, thereby creating a situation beyond common sense in which:

- courtiers, in order for the king to consider them smart, began to pretend that they see the king's clothes that do not actually exist;
- courtiers who would like to tell the truth about emperor's non-existent clothes knew in advance that they would be regarded stupid;
- thus, the situation forced courtiers to tell a lie for career reasons, and thereby contribute to the successful activities of the swindlers.

And as shown in the monograph of the Nobel Prize winner Sir Roger Penrose "The New Mind of the King" [59], which is an allusion to Andersen's fairy tale, quite recently in computer science it was similarly argued about the inevitability of the emergence of a computer civilization [60]-[64], which over time supposed to enslave people. This witty reception of Sir Penrose was so effective that now no one remembers the possible enslavement of people by computers.

And in the situation considered in the article:

- the physical community now recognizes as "smart" those scientists who understand (and at first no one understood and accepted STR) the generally accepted version of STR and believe it to be unconditionally correct, despite the fact that it is refuted by many well-known physical realities;
- and these "smart" scientists even deliberately created – for example, by the OPERA and ICARUS experiments – an incorrect public opinion about the infallibility of the existing version of STR presented in university physics textbooks, which justified their unsuccessful long-term multi-billion dollar costs for the implementation of erroneous scientific concepts;
- at the same time, scientists who try to criticize the generally accepted version of STR, the physical community creates a dubious reputation and difficulties in creative activity.

Thus, from the set forth it follows that the universally accepted version of STR stated in physics textbooks, as it is incorrect, it is quite possible to call on terminology H. H. Andersen's "New King's Delusion". And in fact this new theory is as non-existent as the king's non-existent new dress. But the physical community, ignoring the physical realities refuting this version of STR, as well as the "clever" courtiers in Andersen's fairy tale praises it. And it is even studied in physics textbooks. Nevertheless, as Hans Christian Andersen argued, "the king is naked" and so the generally accepted version of the STR in physics textbooks must be corrected.

5. Conclusions

Therefore it is time to realize that, despite the great significance for science of the principle of relativism, this principle, due to the lack of the necessary experimental knowledge in the 20th century in the generally accepted version of STR, was incorrectly stated using the incorrect postulate about non-exceeding the speed of light, that replaced this knowledge. And over the past century since creation of this obsolete version of the

STR, physics community has canonized it, instead of correcting and developing it further using the alternative version of the STR created in the 21st century [65]-[69]. But Albert Einstein himself does not claim that his version of STO is infallible. He wrote: *"There is no idea in which I am confident that it will stand the test of time"*

Therefore, the conclusion is logical: modern higher physical education is imperfect, because now even in the most prestigious universities students are still being taught knowledge that has already been refuted by modern science.

Acknowledgments

The author gratefully acknowledges the insights, comments, and assistance of Olga Ilyinichna Antonova.

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The idea of using *OOO* (1)-multisignature is an improvement of the BFT method from the ByzCoin blockchain [4], which uses the Schnorr signature scheme to aggregate multivalued signals of constant size and forms a multicast tree among validators to facilitate message delivery. However, the Schnorr multivalued signature requires a secret commitment round,

which results in a total of two round-trip requests for a single multidrop.

The proposed consensus involves the following steps:

1. The leader constructs a new block and broadcasts the block header to all validators. Meanwhile, the leader broadcasts the contents of the block with the coding to the eraser. This is called the "announcement" phase.

2. The validators check the validity of the block header, sign the block header with the BLS signature and send the signature back to the leader.

- 3 The leader waits for at least $2ff + 1$ valid signatures from the validators (including the leader's own signatures) and aggregates them into a BLS multi-signature. The leader then broadcasts the aggregated multi-signature along with a bitmap of the changes the validators have signed. Together with step 3, the 'preparation' phase of the PBFT is completed.

4. The validators check if the multi-signature has at least $2ff + 1$ valid signatures, check the block content transactions broadcast from the leader in step 1, sign the received message from step 3 and send it back to the leader.

5. The leader waits for at least $2ff + 1$ valid signatures and from step 4, combines them together into a BLS multi-signature and creates bitmaps, registers all those who signed. The leader then captures the new block with all signatures, multi-signatures and bitmaps and transmits the new block to all validators. Together with step 5, the PBFT 'commit' phase is completed [1; 5].

Consensus validators are elected on a Proof-of-Stake basis. The proposed protocol differs from the existing PBFT in that a validator with more voting shares has more votes than others, rather than one signature one vote. Instead of waiting for at least $2ff + 1$ signatures from validators, the leader waits for signatures from validators who collectively hold at least $2ff + 1$ voting shares.

The traditional procedure of uploading blockchain history and reconstructing the current state is too slow to allow changes to be repeated (it takes several days for the Ethereum blockchain to fully synchronise history), given that the current state is much smaller than the entire blockchain history. Uploading the current state over a time period of an epoch is possible compared to uploading the entire history. In order to optimise the state synchronisation process, it is suggested to make the blockchain state as small as possible.

In Ethereum, many accounts are empty and waste blockchain state space. Empty accounts cannot be deleted due to possible replay errors when old transactions are resubmitted to a deleted account. This problem can be solved by preventing replay attacks by allowing transactions to specify a hash of the current block: the transaction is only valid up to a certain number (e.g. 300) of blocks following the block of the specified hash. In this way, old accounts can be securely deleted, significantly speeding up blockchain state checking [1].

Thus new validators that join the Shard first load the current state of that shard so that they can quickly

start checking transactions. To ensure that the current uploaded state is valid, the new node must do the appropriate validation. Instead of loading the entire blockchain history and replaying all transactions to verify the current state, the new node loads the historical blockchain headers and verifies the headers by verifying their signatures.

As long as there is a cryptographic component (e.g., hash pointers and signatures) from the current state to the genesis block, the state is valid. Verifying signatures is not computationally inexpensive and it takes a significant amount of time to verify all signatures, starting from the genesis block. To mitigate this problem, the first block of each epoch is proposed to include an additional hash pointer to the first block of the last epoch. In this way, the new node can go through the blocks during an epoch when tracing the hash pointers to the genesis block. This will greatly speed up the verification of the current state of the blockchain [5].

The proposed consensus uses an approach that differs from those previously discussed - with Proof of Share (PoS) as a validator registration mechanism or Sybil attack prevention mechanism. In order to become a validator, future participants (or interested parties) must bid on a certain number of tokens to become eligible to participate. The number of tokens pledged determines the number of voting shares intended for the validator. Such a method contains a main chain and a Shardi set. The main chain serves as an identity registry, while the Shardi chains store individual blockchain states and simultaneously process transactions. This algorithm uses randomness generation by combining a random function checker (VRF) and a delay checker (VDF) and includes PoS in the sharding process, which shifts the fragment protection issues from a minimum number of nodes to a minimum number of voting shares [6].

Each voting particle corresponds to one vote in the BFT consensus. Stakers receive voting shares proportional to their tokens. Voting shares are then randomly assigned to the sharding. The tokens become validators for the fragments for which they vote.

Assigning individual voting shares to Shards rather than individual validators. The safety of sharding by voting shares is that even if for all pledged tokens 14 are malicious validators, one validator is assigned to one Shard. In such a case, in the worst case scenario where a single malicious validator holds all the tokens (voting shares), it is less than 13 voting tokens in that Shard. The reason is that the stakes for each Shard are mm times less than the stakes of the whole network, where mm is the number of Shards. Thus preventing attacks by harmful validators instead of sharding by validators, the voting shares are split (one share, entitled to vote, is assigned to one shard).

In this method, the price of a voting share is set algorithmically, so that it is small enough that harmful participants cannot concentrate their voting power in a single Shard. The share price has voting power is set in tokens.

This solution is functional like the minimum number of nodes in a shard described in other PoW-based solutions [1; 7].

This approach is robust to fluctuations in the number of validators. It does not set a lower limit on the number of validators in each fragment, as in other solutions such as Zilliqa. An adaptive PoS-based model is adopted so that attackers can never occupy more than 13 voting shares in a single Shard, which makes it robust.

Developed criteria, indicators and methods to evaluate the performance of the integrated model for the implementation of blockchain technology in the digital environment of the educational process.

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№46 2023
International independent scientific journal

ISSN 3547-2340

Frequency: 12 times a year – every month.
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