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MEDICAL SCIENCES

PROSTHETICS WITH FIXED OVERDENTURES ON IMPLANTS

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Abstract

The author considers the advantages, disadvantages and methods of preventing complications in the prosthetics of patients with fixed overdentures. It has been proven that individual planning of the design of a subperiosteal implant allows creating the most correct location of the support heads in their required number and ensures high-quality fixation of the prosthesis, leaving a specific clinical situation.

Keywords: subperiosteal implant, fixed overdentures, fixation of prostheses.

Well-known options for prosthetics on implants are the manufacture of a removable, fixed or conditionally removable orthopedic structure. Each of these options has indications and contraindications for use, its advantages and disadvantages [1,7]. The purpose of this work was to determine the criteria for the use of the so-called integumentary structures on subperiosteal implants with a fixed method of fixation on supports.

In order to increase the strength of the structure and for the convenience of the exact location of the fixing elements, the integumentary prosthesis is reinforced with a metal frame. In our opinion, the indication for the use of an integumentary prosthesis is quite large defects in the dentition, especially accompanied by a decrease in the height of the alveolar part of the jaw or a change in the appearance of the periodontal area. To such situations can be attributed to defects in the dentition after a long-standing extraction of teeth (local or generalized atrophy of the alveolar process, deformities of the alveolar process, defects in the alveolar process after previous surgical interventions, soft tissue defects). The advantages of a fixed structure are as follows: the psychological comfort of the patient; simplicity at the stages of laboratory production; the possibility of fixing the prosthesis after the preparation of supports; ease of fixation, leveling the inaccuracy of the casting of the metal frame; the ability to reproduce a full-fledged occlusal surface; the possibility of obtaining a good cosmetic result [2,9]. Despite this, cemented prostheses also have significant drawbacks [3,4]. According to the literature, these shortcomings can manifest themselves after 2–3 years of use [6]. Based on the complaints of patients, clinical examination data and X-ray control, 61 patients had:

- edges of overhanging crowns (87.3%);
- loose marginal fit of crowns to supports (43.4%);
- periapical changes in abutment teeth (35.1%);
- violation of aesthetics (34.5%), among which

dissatisfaction with the color or shape of crowns (27.9%)

- and root exposure (6.6%);
- inadequate form of prostheses (13.2%), in particular, the absence of contacts with antagonists (6.6%),
- occlusal disorders (3.2%), too large flushing space under the intermediate part (3.4%);
- chipping of ceramic cladding (10.1%);
- prosthesis fractures (8.3%);
- violation of fixation of prostheses (8.0%);
- mobility of abutment teeth (4.9%);
- pathology of the marginal periodontium (3.5%);
- loss of neighboring teeth and the need to change prosthesis designs (1.1%)

Such conclusions are in the context of general ideas about the etiology of complications after cementation of prostheses [5, 12]. Summarizing these conclusions, we emphasize that most of the shortcomings are the consequences of the mistakes of the doctor and dental equipment at different stages of the manufacture of the prosthesis. It can be considered positive that a high percentage (8-31%) of the so-called biological complications after non-removable fixation of prostheses can be ignored in the case of prosthetics on a subperiosteal implant [9]. Interesting results were obtained by examination of 102 combined metal-acrylic and metal-plastic crowns after 8-15 years of operation. In 29 crowns, significant wear was found, in 10 cases - a crack in the lining, in 40% - significant wear and damage to the crowns. In addition, during the control period, the subgingival placement of the edges of the crowns on the vestibular side remained only in 16% of cases. Moreover, according to foreign authors, non-removable metal-acrylic and metal-plastic prostheses can acquire cosmetic and structural defects, which will require their restoration or processing after 2-3 year [10,11].

The results of long-term control (5-7 years) of prosthetic treatment on intraosseous implants [2, 4] show similar data: the examination revealed a violation of the safety of the lining associated with the erasure of plastic on the chewing surface of the molars [8]. The development of modern dentistry allows for the clinical restoration of the prosthesis in the oral cavity. First of all, this method justifies itself in the restoration of the cladding. Depending on the facing material, such a restoration can be carried out by mechanical (retentive) fastening of a new portion of the material or by silanization (etching) followed by the use of the classical adhesive technique, or complete reworking [6]. A large complex of problems should be considered complications that have a risk of developing around implantation, namely: mucositis, cuff gingival hyperplasia, peri-implantitis [8]. In all these cases, the situation may require mechanical removal of the prosthesis by knocking down or ultrasonic action. The second option is not recommended.

itself in practice, especially when it is necessary to remove a large structure in terms of the number of supports. Another problem of fixed prosthetics on implants is the risk of spontaneous partial or complete removal of prostheses [6, 7, 8]. cement; edge junction density; the height of the support heads and the angle of the walls; the presence of retention on the fixing surfaces; mechanical loads

act on implosion. Partial decementation of the prosthesis should be considered the greatest threat to the further functioning of the entire system (prosthesis - implant - bone bed), especially when natural teeth are included in the design. This situation leads to inadequate biomechanical loads both on the supports, on which the prosthesis has been cemented, and on the supports, where the fixation has not yet been preserved.

The main factors in the prevention of complications include: the quality of the manufacture of prostheses, in particular, the precision casting of the frame, and the accuracy of its ratio to the ledges of the supports and the clear edge; rational preparation of supports and the choice of adequate material for fixing the prosthesis; timely therapeutic and periodontal treatment; regular follow-up examinations at least once every 6 months. Most complications remain relevant for prosthetics on subperiosteal implants [11]. It should be noted that the manufacture of a subperiosteal implant follows the same principles as the framework of the prosthesis, so special attention should be paid to the planning and manufacture of the prosthetic elements of the implant.

Since the marginal adaptation of the prosthesis is a decisive factor in achieving a long-term positive result, it is important that the edge of the prosthesis fits exactly to the implant shoulder [10].

An important issue considered in the literature is the stage of preparation of supports [20]. Modern research is aimed at finding optimal preparation techniques and creating optimal shapes of prepared teeth [9]. Careful planning of the shape of the prosthetic heads of the implant allows, already at the laboratory stage, to create parallel supports as the most suitable for fixation. In this case, it becomes possible to abandon

the clinical preparation of supports. This greatly speeds up and simplifies prosthetics. The experience of domestic authors indicates the need for a clear distinction between the prosthesis and peri-implant tissues. In the subperiosteal construction, this can be

be achieved by passing a wide ledge into a thin neck [11]. At the same time, the height of the neck is chosen and created, taking into account the phenotype of the gums, which is determined during the first surgical intervention (Classic two-stage subperiosteal implantation). Careful polishing of the implant neck is also of great importance for the long-term well-being of peri-implant tissues. This approach contributes to dense coverage of the supports by soft tissues, prevents mechanical irritation of the gingival margin, simplifies independent and professional hygienic care of implantation. In some situations, such a specific modeling of the implant heads is contrary to the requirements of cosmeticity, but the gingival mask of the prosthesis most often covers all metal elements that may be noticeable. The problem of cosmetic prosthetics becomes even more urgent in the case of using intraosseous implants as supports. Scientific and clinical searches for improvement are carried out in several directions at once (soft tissue plasty, the use of specific gingival shapers, the use of ceramic transgingival elements, the use of heavy-duty ceramics for the manufacture of individual orthopedic heads, the manufacture of metal-free prostheses) [3]. Individual production of subperiosteal implants in the conditions of conventional dental laboratories and insufficient experience in practical work do not yet allow the use of such options for improving cosmetics and leave wide prospects for the development of this topic.

Externally, non-removable integumentary structures resemble conventional removable dentures. But the fundamental difference is that a cemented prosthesis will remain in the mouth for many years. This forces us to focus on reproducing all the anatomical features of the artificial gums and the excellent quality of the prosthesis. These measures will help the patient to quickly adapt to the prosthesis, and in the future will serve as a reliable prevention of inflammatory complications around the implantation. The cosmetic value of plastic gums in the integumentary structure can hardly be overestimated. Therefore, you should use the entire available arsenal of opportunities to improve the "naturalness", namely: careful masking of the metal frame with special varnishes that do not allow translucence through the plastic; overlapping of the metal elements of the prosthesis with a sufficient facing layer of plastic; selection of the required shade of the base plastic in accordance with nearby tissues; application of plastics from capillary pattern; maximum reproduction of the anatomical relief (interdental papillae and vestibular contour of the alveolar process) Individual planning of the design of the subperiosteal implant allows you to create the most correct location of the supporting heads in their required number, regardless of the anatomical conditions of the jawbone; provides high-quality fixation of the prosthesis in accordance with the specific clinical situation. The most acceptable for wide practi-

cal use should be considered a metal-reinforced prosthesis with artificial teeth and a gum mask. The optimal option for fixing a cover prosthesis on a subperiosteal implant is

bolt, lock or screw fixation, which provides constant free access to the prosthesis and peri-implant areas. Therefore, the manufacture of non-removable overdentures on subperiosteal implants cannot be considered the best option from the point of view of long-term control, but it is this fixation option that remains technologically the most accessible today for implementation under modern conditions.

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ASSESSING THE QUALITY OF LIFE AND PSYCHO-EMOTIONAL CHANGES IN PATIENTS WITH CORONARY ARTERY DISEASE WITH CONCOMITANT ONCOLOGICAL PATHOLOGY AFTER CORONARY ARTERY BYPASS SURGERY

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ОЦЕНКА КАЧЕСТВА ЖИЗНИ И ПСИХОЭМОЦИОНАЛЬНЫХ ИЗМЕНЕНИЙ У ПАЦИЕНТОВ ИБС С СОПУТСТВУЮЩИЙ ОНКОЛОГИЧЕСКОЙ ПАТОЛОГИЕЙ ПОСЛЕ ОПЕРАЦИИ АОРТОКОРОНАРНОГО ШУНТИРОВАНИЯ

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Abstract

For the treatment of coronary heart disease (CHD) and the prevention of recurrent attacks of angina, coronary artery bypass grafting (CABG) is considered the most effective method. This operation provides a significant improvement in heart function in 75-80% of cases. This operation provides a significant improvement in heart function in 75-80% of cases. Often the course of the postoperative period in patients with coronary heart disease with concomitant oncological pathology is accompanied by an anxiety-depressive state. To improve the results of surgical treatment, psychological correction methods are used. Despite a significant amount of work on the study of the characteristics of the mental state of cardiac patients, many aspects of this problem remain insufficiently studied. A significant portion of researchers associate the deterioration in the quality of life of cardiac patients with the characteristics of the clinical course of the disease. The source of stress is the fact of being diagnosed with a serious, life-threatening disease in connection with entrenched ideas about the incurability of oncological pathology. In addition, surgical interventions are accompanied by negative emotional experiences. Their result is neuro-psychic disorders of varying nature and severity, primarily asthenoneurotic, anxiety and depressive disorders. At the same time, such psychological aspects as the characteristics of the cognitive sphere (CS) of the patient's personality and their dynamics, as a rule, remain out of focus. The above determined the problem of this study.

Аннотация

Для лечения ишемической болезни сердца (ИБС) и предотвращения повторных приступов стенокардии наиболее эффективным методом признается аортокоронарное шунтирование (АКШ). Данная операция обеспечивает значительное улучшение функций сердца в 75-80% случаев. Часто течение послеоперационного периода у больных с ишемической болезнью сердца с сопутствующей онкологической патологией сопровождается тревожно-депрессивным состоянием. Для улучшения результатов хирургического лечения применяются методы психологической коррекции. Несмотря на значительное количество работ по исследованию особенностей психического состояния пациентов кардиологического профиля, многие аспекты данной проблематики остаются недостаточно изученными. Значительная часть исследователей связывает ухудшение показателя качества жизни пациентов кардиологического профиля с особенностями клинического течения заболевания. Источником стресса является факт установления диагноза тяжелого, угрожающего жизни заболевания в связи с укоренившимися представлениями о неизлечимости онкологической патологии. Кроме того, хирургические вмешательства сопровождаются негативными эмоциональными переживаниями. Их результатом становятся различные по характеру и степени выраженности нарушения нервно-психической сферы, прежде всего астеноневротические, тревожные и депрессивные расстройства. При этом, такие психологические аспекты, как характеристики когнитивной сферы (КС) личности пациентов и их динамика, как правило, остаются вне фокуса. Вышесказанное определило проблему настоящего исследования.

Keywords: coronary heart disease, oncopathology, coronary artery bypass grafting on a beating heart, anxiety-depressive state.

Ключевые слова: ишемическая болезнь сердца, онкопатология, аортокоронарное шунтирование на работающем сердце, тревожно-депрессивное состояние.

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В последние десятилетия отмечается устойчивая тенденция к росту заболеваемости ишемической болезни сердца (ИБС), связанная также с увеличением продолжительности жизни населения и доли пациентов пожилого возраста. Одной из целей национального проекта «Здравоохранение» является снижение к 2024г. показателя смертности от болезней системы кровообращения до 450 на 100 000 человек в году путем реализации программы на всех этапах: от профилактики сердечно-сосудистых заболеваний (ССЗ) до реабилитации после перенесенных заболеваний и операций (Национальный проект «Здравоохранение»: Федеральный проект «Борьба с сердечно-сосудистыми заболеваниями (2018-2024 г.г.)» [1].

В настоящее время в структуре заболеваемости и смертности населения России, как и всего мира, лидирующие позиции занимают сердечно-сосудистые и онкологические заболевания. В России в 2018 г. количество умерших от ССЗ составило 856,1 тыс. (вклад ишемической болезни сердца — 453,3 тыс. (52,9%)), от онкологических заболеваний — 297,9 тыс. человек [2,3]. По прогнозам экспертов Всемирной Организации здравоохранения (ВОЗ) возможен дальнейший рост числа заболеваний сердца и сосудов, повышение смертности от них, во всем мире. Это обусловлено увеличением продолжительности жизни населения и особенностями образа жизни [4, 5].

Смена подходов к оказанию медицинской помощи — современная тенденция, охватившая многие государства мира. Сегодня в развитых странах мира медицинская модель, имеющая своей целью только устранение заболевания и восстановление функционирования человеческого организма, постепенно сменяется моделью, ориентированной на психосоциальный подход. Подобная концепция требует не только восстановления биологической функции организма, но и нормализации его психологического и социального функционирования [6, 7, 8].

Многочисленные исследования, завершившиеся в конце 90-х годов XX в., позволили доказать, что стресс и вызванные им состояния, прежде всего тревога и депрессия, являются независимыми факторами риска развития сердечно-сосудистых заболеваний [9]. В настоящее время в медицине используются различные инструменты изучения качества

жизни (КЖ) пациентов [10, 11]. Одни из них предназначены для анализа жизненного благополучия в целом и общего состояния здоровья пациентов, другие — для оценки КЖ отдельных групп пациентов с учетом особенностей заболевания, третьи — для оценки влияния болезни и лечения на отдельные сферы жизни человека [12]. Течение онкологического заболевания и его лечения значительно влияет на самочувствие пациентов и, как следствие, обуславливает необходимость четкого понимания врачом реабилитационных потребностей больных. Это вызывает необходимость применения специальных инструментов оценки КЖ. Одним из таких инструментов, отражающих субъективную оценку пациентами симптомов и жизненного функционирования при онкологической патологии, является разработанный Группой оценки качества жизни (Study Group of Quality of Life) при Европейской организации по исследованию и лечению рака (European Organization for Research and Treatment Cancer, EORTC) опросник «Утомление» ("Fatigue", FA12) [11], который является модулем специализированного опросника качества жизни при онкологической патологии (Quality of Life Questionnaire — Core 30, QLQ-C30), созданного этой же организацией [13]. Оригинальный текст опросника на английском языке и форма запроса русскоязычной версии представлены на сайте EORTC (<https://qol.eortc.org/questionnaire/qlq-fa12>). Этот метод можно использовать и для изучения динамики данных показателей в процессе восстановительного лечения и реабилитации пациентов после хирургического вмешательства и химиотерапии. Наибольшее количество специфичных опросных форм создано для пациентов с хроническими и онкологическими заболеваниями, а также различными состояниями [14, 15].

В связи с изложенным важной является психологическая коррекция тревожно-депрессивного состояния онкологических больных с ишемической болезнью сердца при комплексной подготовке к хирургическому лечению — аортокоронарному шунтированию на работающем сердце. Цель настоящего исследования — оценка возможности психологической коррекции тревожно-депрессивного состояния для улучшения результатов хирургического лечения онкологических больных с ИБС.

Материалы и методы

Обследовано 82 пациента ИБС (средний возраст $61,1 \pm 6,0$ лет) с сопутствующей онкологической патологией различной локализации, которые перенесли в плановом порядке операцию аортокоронарного шунтирования на работающем сердце (OPCAB — Off-pump coronary artery bypass). Доля мужчин составила 70,7%, женщин — 29,3%. Инфаркт миокарда в анамнезе отмечен у 62 (75%) пациентов. У всех пациентов по результатам анализа представленной медицинской документации, отмечалось наличие коморбидной патологии. Так арте-

риальная гипертензия выявлена у 68 (83%) пациентов, сахарный диабет (СД) 2 типа – у 22 (26%) пациентов, хроническая обструктивная болезнь легких (ХОБЛ) – у 19 (23%), хроническая болезнь почек (ХБП) – у 13 (15%), дислипидемия – у 60 (73%), язвенная болезнь желудка и 12 перстной кишки в анамнезе отмечена у 16 (19%) пациентов. Следует отметить, что доля активных курильщиков ($n=27$) до госпитализации превышала 33%. Для расчета индекса массы тела (ИМТ) использована формула Кетле. Ожирение диагностировали по классификации ВОЗ (2007) [16]. В соответствии с рекомендациями 2020 г. по лечению дислипидемий, последнюю диагностировали при уровне общего холестерина более 5,0 ммоль/л, холестерин липопротеинов низкой плотности более 3,0 ммоль/л, триглицеридов 1,7 ммоль/л и более, холестерин липопротеинов высокой плотности – менее 1,0 ммоль/л [17]. СКФ рассчитывали по формуле CKD-EPI (2009, модификация 2011). ХБП и ее стадию определяли согласно клиническим рекомендациям (2020) [18].

На момент госпитализации у 39 (47%) пациентов лечение сопутствующей онкологической патологии еще не проводилось. Остальным 43 (53%) пациентам противоопухолевое лечение проводилось ранее в период от 1 до 8 лет до развития ИБС (средний срок $3,5 \pm 1,9$ года). Таким образом, в различные сроки до госпитализации по поводу ИБС противоопухолевое лечение начато или проведено 43 больным, из которых: хирургическое лечение проводилось у 13 (30%), курсы химиотерапии – 18 (42%), лучевая терапия – 7 (16%) пациентам. Комбинированное лечение получали 5 (12%) пациента.

Клиническую характеристику анализируемых больных отягощали повышенный уровень тревоги (во всех без исключения случаях) и депрессивное состояние (у 1/3 больных). Всем больным проводили традиционную предоперационную подготовку, однако, несмотря на оптимальную медикаментозную терапию (β -адреноблокаторы, статины, дезагреганты), модифицируемые факторы риска развития ССЗ продолжали определяться: дислипидемия – в 11,4% случаев, сахарный диабет – в 7,9%, артериальная гипертензия – в 7,3%. Оценка уровня клинической депрессии проводилась с помощью шкалы депрессии А. Бека (Beck Depression Inventory-BDI), которая предназначена для определения тяжести депрессивной симптоматики. Общий результат 0-9 баллов свидетельствовал об отсутствии депрессивных симптомов, результат 10-19 баллов оценивался как легкая депрессия (субдепрессия) и умеренная депрессия, более 19 баллов – клинически значимая депрессия. Оценка уровня ситуативной и личностной тревожности осуществлялась с помощью теста, разработанного Ч. Спилбергером и Л. Ханиным; этот тест позволяет выявить уровень тревожности у пациента на момент проведения исследования и тревожность как личностную черту. Уровень тревожности менее 30 баллов оценивался как низкий, 31-44 балла – умеренный, 45 и более баллов – высокий. У всех пациентов изучалось качество жизни, определяемое в баллах с ис-

пользованием анкеты SF-36, Миниссотского опросника. Контрольное обследование включало в себя: ЭКГ, ЭхоКГ, оценку качества жизни с использованием опросников (Seattle Angina Questionnaire – SAQ, специфический опросник для онкологических больных EORTC QLQ-C30 и общий опросник SF – 12). Все исследования проводились амбулаторно на базе ФГБУ «НМИЦ ССХ им. А.Н. Бакулева» МЗ РФ.

Статистическая обработка результатов проводилась в программной среде SPSS 23.0 (IBM Inc., США). Результаты представлены в виде среднего арифметического (M) и среднего квадратичного отклонения (SD). Для сравнения количественных показателей двух независимых групп при нормальном распределении признака применяли критерий Стьюдента (t). Различия считались достоверными при $p < 0,05$. Клинико-психологическое обследование проводили до операции, через 1, 2 и 2,5 года после операции. Для статистической обработки результатов использовали методы дескриптивной статистики, тест Колмогорова–Смирнова с целью оценки распределения переменных, тест Уилкоксона, критерий Манна – Уитни, корреляционный анализ по Пирсону и по Спирмену.

Результаты и обсуждение

Отдаленная летальность после проведенного лечения сопутствующих злокачественных новообразований составила 8,5% — 3 пациента умерли через 1, 2 и 2,5 года после операции малоинвазивной реваскуляризации миокарда (МИРМ) на работающем сердце. Причиной смерти послужила конкурирующая онкологическая патология. На данный момент 11,4% больных получают курсы терапии: гормональной — 5,7%, химиотерапии — 5,7%. Проведенное нами исследование выявило значимые статистически различия показателей методики SF-36, которые были получены до операции реваскуляризации миокарда и после нее, выявленные по шкалам «Физическая активность», «Общее здоровье», «Роль проблем эмоционального характера» «Роль физических проблем», «Боль», «Психическое здоровье» и «Жизненная активность». В каждом случае показатели качества жизни после операции оказались существенно более высокими по сравнению с дооперационным периодом. Особенно это касается показателя «Физическая активность», который по своему значению в послеоперационном периоде приближается к максимально возможному (100%). После второго этапа лечения, качество жизни оценивалось с использованием анкеты-опросника Европейской организации исследования и лечения рака (EORTC QLQ-C30), содержащего 30 вопросов. Современная версия EORTC QLQ-C30 включает следующие основные шкалы: пять функциональных шкал, отражающих физический (PF), ролевой (RF), познавательный (когнитивный) (CF), эмоциональный (EF) и социальный (SF) статус; три соматических шкалы, включающих утомляемость (FA), боль (PA), тошноту и рвоту (NV); шкалу состояния здоровья в общем и уровня качества жизни (QL2). Анализ полученных данных в течение 2-х лет

наблюдения выявил значительное улучшение показателей по шкалам физического и когнитивного функционирования, а также уменьшение слабости ($p < 0,01$). Показатель утомляемости снижался постепенно и к двум годам этот показатель достиг наименьших значений (с $45,72 \pm 3,1$ до $26,19 \pm 4,1$; $p < 0,05$). После проведенного лечения конкурирующей онкологической патологии у всех пациентов сохранялась тенденция к уменьшению показателей по шкалам тошнота и рвота (с $6,4 \pm 1,1$ до $5,3 \pm 1,96$ ед., $p < 0,1$). Рост показателя качества жизни, в исследуемой группе пациентов, определен физической и социальной адаптацией пациентов, и снижением уровня тревожности, которая вызвана заболеванием и проводимым лечением. Таким образом, хорошие средне-отдаленные результаты (до 2-х лет) операции (отсутствие стенокардии, отрицательный нагрузочный тест) были получены у 95,8% пациентов, через 2,5 года — у 87,5% больных. Также отмечены относительно хорошие показатели качества жизни. Данные, полученные с помощью опросников качества жизни, позволяют осуществлять постоянный контроль состояния пациентов и коррекцию терапии на протяжении всего периода наблюдения.

Данные, полученные с помощью шкалы депрессии Бека, демонстрируют, что 65% пациентов имеют показатели ниже 10 баллов (средний балл $4,8 \pm 2,7$), что свидетельствует об отсутствии депрессии у этих больных. Однако 26% пациентов имеют показатель от 10 до 19 баллов (средний балл $14,1 \pm 3,7$), что не превышает нормальные значения, однако вызывает опасение в отношении перспективы развития депрессии. У 9% больных выявлены признаки клинически выраженной депрессии с баллом более 20 (средний балл $27,4 \pm 5,8$), что свидетельствует о необходимости коррекции проводимого лечения. В результате корреляционного анализа выявлены положительные взаимосвязи между качеством жизни и уровнем депрессии ($r = 0,51$, $p < 0,001$). Качество жизни у пациентов с сопутствующей депрессией в 1,5 раза хуже, чем у лиц с нормальным психоэмоциональным статусом.

Результаты использования шкалы определения тревожности Спилбергера-Ханина показали, что уровень ситуативной тревожности у пациентов значительно ниже, чем уровень личностной тревожности. Так, низкий уровень ситуативной тревожности отмечен у 9% больных (средний балл $29,3 \pm 3,7$), низкий уровень личностной тревожности не был зафиксирован ни у одного из обследованных пациентов. Средний уровень выраженности ситуативной тревожности наблюдался у 69% больных (средний балл $40,4 \pm 3,2$), а личностной тревожности — у 50% (средний балл $40,8 \pm 5,4$). Высокий уровень ситуативной тревожности был выявлен у 22% пациентов (средний балл $53,6 \pm 8,0$), личностной тревожности — у 50% (средний балл $53,8 \pm 8,1$). Обнаружены корреляционные взаимосвязи между качеством жизни и уровнем ситуативной тревожности ($r = 0,46$, $p < 0,001$), а также между качеством жизни и уровнем личностной тревожности ($r = 0,59$,

$p < 0,001$). Качество жизни у пациентов с сопутствующим высоким уровнем личностной тревожности в 1,6 раза хуже, чем у лиц с нормальным психоэмоциональным статусом.

Оптимальным является такой уровень тревожности, который сопоставим с объективными условиями, ее вызвавшими, и который достаточен для мобилизации сил на преодоление возникающих препятствий. Равнодушие к трудностям и безответственное отношение к поставленным целям при полном отсутствии ситуативной тревожности снижает эффективность деятельности и не позволяет достичь наилучших результатов [3]. Однако и повышенная ситуативная тревожность, при которой возбуждение и беспокойство значительно превышают уровень возможных затруднений, снижает результативность деятельности. Таким образом, повышенная ситуативная тревожность имеет дезадаптивный характер. Высокий уровень личностной тревожности требует помощи специалистов и длительной психотерапии, поскольку соматические проявления тревожности (учащенное сердцебиение и пульс, нарушения со стороны желудочно-кишечного тракта, нарушения дыхания) могут вызвать развитие различных заболеваний или усугубить течение уже существующих. В нашем исследовании повышенный уровень тревоги характеризовал реакцию пациента на предстоящее хирургическое вмешательство. Ряд авторов трактуют повышенную тревогу и депрессию как состояние, вызванное стрессом, и дополнительный фактор риска развития ССО в послеоперационном периоде [19, 20, 21].

Согласно данным метаанализов, предоперационный скрининг психических нарушений позволяет оценить риск послеоперационной тревоги и депрессии у пациентов, подвергаемых операции аортокоронарного шунтирования (АКШ) [22, 23]. Данные по распространенности депрессии у пациентов перед и после коронарного шунтирования сопоставимы с результатами зарубежных регистровых исследований [24, 25]. В то же время нами не обнаружен рост частоты депрессии после вмешательства, как это отмечено в работе В. Krobmacher и соавт. [26], где состояние пациентов оценивалось при помощи самоопросника Госпитальной шкалы, а риски развития депрессии в послеоперационном периоде коррелировали с тяжестью осложнений после вмешательства. Снижение частоты и уровня тревоги после аортокоронарного шунтирования отражает динамику нозогенной тревожной реакции личности. Полученные данные указывают на необходимость коррекции расстройств настроения в предоперационном периоде после операции АКШ. На примере исследований по оценке влияния психологического консультирования перед большими абдоминальными оперативными вмешательствами [27] видно, что такого рода интервенции позволяют снизить интенсивность боли и тревожность у пациентов.

Заключение

Согласно результатам проведенного исследования, даже в отдаленном периоде после проведен-

ной операции АКШ, у пациентов с сопутствующими онкологическими заболеваниями сохраняются признаки психоэмоциональной нестабильности, качество жизни больных значительно ухудшается при наличии тревоги или депрессии. У пациентов, подвергаемых плановой операции АКШ, спектр пред- и послеоперационных эмоциональных нарушений складывается из предоперационных тревожных и депрессивных реакций на ситуацию (субклинической или клинической выраженности), уровень которых снижается после хирургического вмешательства. Выраженность тревоги и депрессии в существенной мере определяет как психологическую, так и физическую составляющую качества жизни пациентов.

Таким образом, выявленные изменения свидетельствуют о необходимости коррекции психоэмоциональных нарушений в комплексном лечении, с целью улучшения клинического состояния и повышения качества жизни этих больных. Изучение данного вопроса важно для повышения качества медицинской помощи этой категории больных.

Конфликт интересов: отсутствует

Финансирование. Исследование не имело спонсорской поддержки

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THE USE OF CALCIUM-CONTAINING PREPARATIONS IN THE TREATMENT OF PERIODONTITIS IN PRIMARY TEETH IN CHILDREN

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ПРИМЕНЕНИЕ КАЛЬЦИЙ СОДЕРЖАЩИХ ПРЕПАРАТОВ ПРИ ЛЕЧЕНИИ ПЕРИОДОНТИТОВ ВРЕМЕННЫХ ЗУБОВ У ДЕТЕЙ

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Abstract

Improvement of dental care, implementation help children, widespread of planned sanitation and dental medical examination have led to a significant reduction in the number of patients with complicated forms of caries. However, a large number of children are still referred for treatment of periodontitis.

Аннотация

Совершенствование стоматологической помощи детям, широкое внедрение плановой санации и стоматологической диспансеризации обусловили существенное снижение числа больных с осложненными формами кариеса. Однако все еще направляется большое количество детей для лечения периодонтита.

Keywords: temporary teeth, dental treatment, calcium-containing preparations, childhood, periodontitis, endodontics, Calcipast.

Ключевые слова: временные зубы, стоматологическое лечение, кальций-содержащие препараты, детский возраст, периодонтиты, эндодонтия, Calcipast.

Проблема лечения хронических периодонтитов временных зубов продолжает оставаться важной главным образом потому, что до сих пор отсутствуют клинические симптомы, определяющие показания к консервативному лечению зуба. В практике детского стоматолога еще очень прочны убеждения, что определить показания к хирургическому или консервативному лечению можно, ориентируясь на возраст ребенка.

Хроническое воспаление периодонта – длительный процесс, которому предшествовало воспаление и гибель пульпы. В результате гибели пульпы и патологических изменений в периодонте процессы роста и формирования корней нарушаются, возможна патологическая резорбция корней. Сроки первичных изменений, так же как и характер их, учесть не представляется возможным. Следовательно, возраст ребенка при наличии хронического периодонтита не может указать врачу на состояние корней.

Неразумно оставлять инфицированные молочные зубы не леченными. Анатомическое строение корневых каналов молочных зубов значительно усложняет эндодонтическое лечение и делает его непрактичным. Каналы первых молочных моляров часто оказываются очень узкими, недоступными даже для самого маленького пульпоэкстрактора. Эндодонтическое лечение зубов с некротизированной пульпой показано, только если корневые каналы хорошо проходимы, а окружающая костная ткань здорова. Если второй молочный моляр приходится удалять до прорезывания первого постоян-

ного моляра, врач неизбежно сталкивается с проблемой мезиального сдвига первого постоянного моляра при прорезывании. Поэтому в таких случаях следует приложить все усилия, чтобы сохранить второй молочный моляр, даже если его пульпа некротизирована.

Материал и методика. Для лечения молочных зубов использовали пасту «Calcipast». Препарат для временного заполнения корневых каналов на базе гидроокиси кальция в виде пасты, не требует дополнительного смешивания. Оказывает стимулирующее действие образования минерализованных барьеров. После пломбирования корневых каналов начинается долговременное высвобождение ионов кальция. При затяжных воспалительных процессах оказывает осушительное действие на инфицированные корневые каналы.

Пасты «Calcipast» широко применяются в практике для лечения инфицированных корневых каналов. За счет стерильности препарата достигается высокий антибактериальный потенциал, при котором 90% случаев бактерий в инфицированном корневом канале погибает полностью уже в течение 1-6 минут. Также достоинством пасты «Calcipast» является коагуляция и полное растворение некротических тканей, что является препятствием к созданию благоприятной питательной среды для микроорганизмов и их дальнейшему росту.

Лечение различных форм периодонтитов с применением пасты «Calcipast» проводили детям в возрасте от 5 до 9 лет. Всего пролечено 22 зуба, из них с хроническим гранулирующим периодонти-

том было 15 зубов, с хроническим фиброзным периодонтитом 3 зуба. Преобладающей формой заболевания был хронический гранулирующий периодонтит. В области молочных моляров нижней челюсти чаще наблюдали разрежение костной ткани в области бифуркации корней. Большое внимание уделяли эндодонтической обработке корневых каналов. Для этого кариозную полость формировали так, чтобы эндодонтические инструменты свободно проникали в канал и хорошо прилегали ко всем его стенкам, что очень важно для полного удаления распада пульпы, очищения корневого канала и полноценного его пломбирования. Антисептическую обработку производили 0,02% раствором хлоргексидина биглюконат, гипохлоритом натрия, так, как они обладают низкой токсичностью, растворяют некротизированные ткани, оказывает бактерицидное воздействие. Корневые каналы запломбировали пастой «Calcipast» максимально на глубину 1/3 верхушечного отверстия нажимая на поршень шприца до момента, пока паста дойдет до апикального отверстия. Излишки пасты удаляли при помощи стерильного тампона. При наличии остаточных явлений воспаления в периодонте лечение заканчивали в следующие посещения. На уровне апикального отверстия запломбировано 16 зубов, не доходя до апикального отверстия 4 зуба и с выведением пломбировочного материала за апикальное отверстие 2 зуба. С целью профилактики обострения хронического воспаления в периодонте детям назначали противовоспалительные, гипосенсибилизирующие, иммуностимулирующие средства.

Результаты и их обсуждение. Непосредственно после лечения хорошие клинические результаты получены в 90% наблюдений, несмотря на то, что до лечения хронический периодонтит часто протекал с обострениями, образованием свищевых ходов на десне, лимфаденитом. Обострения после

пломбирования возникли у 3 больных. Больные жаловались на болезненность при надавливании на зуб, гиперемией слизистой оболочки в области пролеченного зуба, которые исчезали самостоятельно в течение 3-5 дней и после применения физиотерапевтических процедур. Через каждые 3, 6 месяцев проводили контрольные осмотры с помощью рентгенологического исследования. Обратили внимания на жалобы больных, клиническое состояние зуба и слизистой оболочки альвеолярного отростка в области ранее леченного зуба. Частичное или полное восстановление костной ткани отмечено 7 зубам, стабилизация процесса в 12, ухудшения состояния в 3. Резорбция корней молочных зубов чаще проходила параллельно с рассасыванием пасты, наличие пасты за верхушкой рассосавшегося корня не оказывало отрицательного действия на дальнейшее формирование фолликула постоянного зуба и рассасывание корней молочных зубов.

Таким образом, лечение временных зубов с пастой «Calcipast» инактивирует микрофлору, стимулирует остеобластический процесс, обеспечивая быстрое образование вторичного заместительного дентина, обладает бактерицидным действием, не препятствует восстановительным процессам в тканях пародонта, способствует физиологической резорбции корней молочных зубов и дальнейшему формированию фолликула постоянного зуба.

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PEDAGOGICAL SCIENCES

BASIC CONCEPTS ABOUT AUDIOVISUAL METHOD

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Abstract

Audio-visual method combines vision and sound which are very effective in foreign language learning. Films, clips, TV show programs and newlines in English are of great significance in L2 acquisition. The usage of native language is ignored while teaching the foreign language through this method. Application of Audio-visual materials only lacks speaking skill. Since there is no one to build up a communication with. A learner can easily polish his/her reading, writing and listening skills. However, all these three skills help to develop speaking skill, as well. The Audio-visual method is composed of educational digital materials. For this reason, it is sometimes called educational material. Hence, "audio-visual aids" or teaching materials refer to such technologies which attempt to make knowledge understandable to us through our senses.

Keywords: television, audio-visual materials, media, DVD, Audio-visual method

Educational tools that can convey meaning without just depending on spoken symbols or language are frequently referred to as audiovisual materials [10].

Textbook or reference material is not included in the scope of audiovisual teaching aids. Shabiralani, Hasan, Hamad, and Iqbal note that primary school students learn more easily and quickly with audiovisual devices than with verbal instruction. Their study's findings also showed that the majority of educators and learners view the usage of visual aids favorably. Mercedes and Amelia, [9] highlights the effectiveness of visual material in learning, estimating that approximately 40% of what is acquired is achieved through visual experience, 25% through auditory, 17% through touch, 15% through various organization, and 3% through taste and smell. This claim clarifies the value of audiovisual assets in the teaching and learning process. The audiovisual method is one of the methods that can be used in the classroom during the lesson for kindergarten and primary school students. This method allows users to make effective use of both visual and audio media and also enables the inclusion of educational materials. Improvement of access to electronic and multimedia technologies and their accessibility have enabled more students to actively participate in the educational process. Teaching and learning are more successful and valuable when using audiovisual aids. This is one of the best ways to spread knowledge and information. The use of audiovisual means such as television, video, cinema, projector, computer in the lesson helps to enrich students' cognition, stimulates their interest, and creates a creative environment.

Audio visuals are an important part of education today as they help students learn better. This is one of the reasons why the use of audiovisuals in teaching, learning and research has increased over the years. The speed with which students can instantly access information and share it with others has increased dramatically. Moreover, students are already able to understand concepts and ideas better and faster. Thanks to

audiovisual media, there have been great advances in education in the last few decades.

In the era of teaching modern languages, various innovations are applied in the ELT industry that go beyond the traditional teaching approaches. The current trend is towards communicative language teaching rather than traditional grammar teaching. The urge to learn a new language has evolved into a communicative need; in the past, acquiring a new language meant learning to read literature in that language. To converse with members of other cultures who speak other languages, people study a second language in addition to their home tongue. As a result, language is taught as a tool for communication rather than as a topic. As a result, methodologies and learning strategies have been modified to meet the evolving demands of language learning. In an effort to improve the effectiveness of their instruction, foreign language teachers always seek for new innovations. It is not simple to teach a language, thus the material should be engaging enough to help students get past their anxieties.

Audiovisuals are learning devices used in the classroom to stimulate learning and make learning easier and more enjoyable. It follows Farouk's A.V.A. so-called audio-visual aids or teaching materials are aids that try to make knowledge clear to us through our senses [4, p. 56]. Meanwhile, according to Francis, the term *audiovisual materials* is usually used to refer to teaching materials that can be used to convey meaning without relying entirely on verbal symbols or language. In other words, A.V.As are teaching materials used by teachers to present the material in an attractive way to facilitate the auditory and visual experience of the student [5]. Authentic materials always facilitate the learning process. Babayev Javid underlines the importance of authentic materials: "They make the students face with real life situations. The students live the situations in real life and these materials willy-nilly depict native speakers' words and behaviours. They are not worse than the artificial texts given in created materials that

have been especially written to exhibit special grammatical rules or relation types.” [2, p.33].

According to the Terrebonne Parish Library System, Audio-visual convey information primarily through sound and images rather than through text. As students become more accustomed to technology, the role of audiovisual materials in the classroom is increasing. Students learn in different ways, so using audiovisual components helps improve the learning environment.

The audiovisual method is one of the methods that can be used in the lesson during the lesson for elementary school students. It uses both visual and audio media and allows you to embed learning materials. Improved access and accessibility of electronic and multimedia technologies have enabled more students to participate in classes. For this reason online lessons also provide the students audio-visual materials. Babayev Javid emphasizes the significance of online learning in his article: “it has become a reality for everyone to recognize and accept online learning as a priority” [3, p.67]

Audio-visual method is also called educational material. Sound literally means "hearing" and "sight" means revealed through sight. Thus, "audio-visual aids" or teaching materials refer to all such technologies that attempt to make knowledge understandable to us through our senses. All of these instructional tools give us first-hand knowledge through the senses of hearing and seeing while making the learning scenarios as realistic as feasible. Thus, audiovisual content can be seen as any tool that can be utilized to enhance the learning process by making it more dynamic, realistic, and concrete. Through our senses, we learn. Experiences give us knowledge. Every sense aids in our ability to perceive our surroundings. The majority of the information we learn in school is absorbed through our eyes and hearing. Reading is less significant than doing in our educational system. You can make theoretical, linguistic, and dull things more natural and enjoyable. Audio-visual materials According to Brinton, audio-visual materials are educational materials that present information to students that do not require the use of paper and pencil. Audiovisual materials are useful in teaching because they take the teaching away from a textbook-only approach. Computers, televisions, cassettes, video or DVD discs and projectors, radios are all types of audiovisual material. Posters, cartoons, clothes, models and tours are also audiovisual. In the classroom, films, audio recordings, and videotapes can be used as substitutes for face-to-face student-teacher communication. These forms of education can be used in continuous public schools where there are not enough teachers. Typically, informative and motivational films and videotapes on selected topics aired on various television networks are typical of this type of material, providing real-life depth for students. Here, teachers can use audiovisual materials to reinforce their teaching in a lecture or activity-based lesson context. After that, teachers can show any motivational film according to the requirements of the situation and the relevant topic.

Mere words written or spoken by a teacher cannot and will not provide an adequate learning experience.

We have to complete the teacher's words. In this regard, visual aids in the form of pictures, cards, posters, etc. help a lot. Again, listening in the language is a very important skill. If we do not have the opportunity to listen to a language, we will not be able to speak it properly. Thus, poetry, fairy tales, etc. audio cassettes containing statements are needed. Such materials will be not only interesting but also motivating for the student.

The use of audiovisuals in the educational environment is important in many ways. Part of their importance is that they can adapt to different learning styles, which ensures effective learning. Some mature learners learn best when they see what is being said. Additionally, others learn best when they can touch or experience something as it is taught to them. Others may fully understand by relying on hearing alone, etc. Aggarwal, Lumsdaine, and Glaser (1960) explain that the effectiveness of students in acquiring new knowledge, skills, and abilities depends on the methods used and the students' learning styles what techniques to use.

Televisions are still used in some classrooms today instead of projections. Some teachers still use tapes to show movies on TVs, but more and more people are using DVD players, one of the achievements of the digital revolution. Many classrooms don't even need a separate player because modern computers have DVD drives. Using a computer to play DVDs in the classroom requires a computer projector, but many classrooms are increasingly equipped with this latest audiovisual equipment. Audiovisual materials are now often in the form of a computer file played using software installed on the teacher's computer. Instead of purchasing DVDs for classroom use, schools sometimes subscribe to digital video services, such as United Streaming, which is available through Discovery Education. These services provide Internet access to tens of thousands of videos—far more than any teacher could have in their classroom collection. Access is immediate; no need to wait for the goods to be shipped.

Mamun investigated the use of AVA in teaching. The purpose of the study was to investigate the benefits of language teachers as well as students using audiovisual aids in teaching English. In addition, other experts found more extensive research on the use of A.V.A. Mathew and Alidmat reviewed the usefulness of AVA in an undergraduate EFL classroom, and as a result, AVA became one of the learning tools that helped most students [7]. Meanwhile, Merdas investigated students' active vocabulary more deeply [8]. The results show that A.V.A plays an extremely important role in increasing students' ability to use active vocabulary.

As you know, the teacher uses different approaches to teach his students, helping them to learn actively. Over the years, teachers' efforts in the field of education have included various methods and techniques. One such method used by teachers to ensure effective teaching is the use of audiovisual aids [1]. Audiovisual resources engage students and help teachers illustrate concepts easily. These audiovisual resources are mainly teaching aids used in the classroom to help and encourage students to understand the context. Au-

audiovisual media, in Burton's opinion, encourage and facilitate efficient learning. In addition, Kinder suggested that the learning process can be made more realistic, accurate and active by using audiovisual resources [6]. Typically, this type of learning is not fostered in most school systems. Implementing this learning in the classroom requires a lot of knowledge and experience.

Many teachers who use these audiovisual resources in their classrooms lack the experience required to get the most out of these tools. Rather, they use these resources to relieve students of the burden of explaining context. For example, some teachers use a text description, illustration or video presentation of the topics they want to teach and just start the presentation without explaining anything properly and thus the lecture time passes easily. Teachers should plan properly before using audiovisuals [11]. In addition, teachers are not working on their students' visual literacy.

The word CREDIF, which stands for the audiovisual approach, was initially used in France in the 1950s. At the beginning of learning a second or foreign language, this approach is meant to teach common language. It was founded on a behaviorist theory that claims language is learned via the development of habits. It is based on the assumption that foreign language is essentially a mechanical process and is more effective if the spoken form precedes the written language. Emphasis was placed on speaking skills and a carefully structured sequence of exercises, as well as the idea that the quality and consistency of learning is directly proportional to the amount of practice performed.

The principle of audiovisual method is as the followings:

- * Picker
- * Training
- * Physical control
- * Correct presentation
- * Answer

Teachers employ teaching tools, such as audiovisual aids, to help pupils understand specific ideas more clearly and successfully. These books can be used for a variety of English teaching objectives. The connection of the learning material to the subject being studied, the accomplishment of a learning objective, and its appropriate use are all indicators of its efficacy.

Good learning is the cornerstone of any educational program, as F. W. Noel clearly observes. This foundation includes visual teaching tools. As a result, an English teacher needs to be knowledgeable about the several audio-visual tools available to him.

The use of audiovisual elements to stimulate and facilitate the acquisition of a second language is well established.

Language learners can benefit from a variety of media and visual presentation approaches, according to Wright [13, p. 1]. In other words, if used properly and at the appropriate times, all audiovisual products benefit language learning. The learner employs both his eyes and hearing when learning and teaching a language, but his eyes are the key to learning.

Research shows that most students in a regular classroom need to see information visually to remember it. Visual learning encourages students to process

what they see and filter it in their brains because they see that ideas are connected, organized, and connected. Visual learning has expanded teaching methods in schools by providing students with simpler methods so that any subject they learn can be fully explained visually. New concepts are easier to understand, especially if they can be related to the previous topic.

River says that it amplifies the benefits of learning another culture by putting listeners and viewers in indirect contact with native speakers [12, p.399].

There are some characteristics that can be used to determine how important audiovisuals are in the learning process. And their value depends on how well they help to achieve the goals of the guidelines and can be summarized under the following headings:

- Compatibility
- Accuracy
- Interest
- Clarity
- Motivation
- Realism

When choosing and using visual aids, we should try to select as aids that connect new experiences with past experiences and that are already in the minds of the students who will use them.

A visual medium must have the quality and niche to develop real ideas about different areas of life. Instead, we can try to develop in our students a concept very similar to the idea of the movement of electrons in an atom. In this case, we teachers try to describe it as accurately as possible with the help of diagrams and tables, and students are shown a real film about the movement of electrons; a completely different but effective concept will emerge. Almost all visual aids lack some features, but the actual example clarifies the concept through realism, so that learners experience this fact in a hands-on approach to learning and understanding.

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INTERNAL AND EXTERNAL FACTORS THAT AFFECT THE ENGLISH LANGUAGE ACQUISITION

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ВНУТРЕННИЕ И ВНЕШНИЕ ФАКТОРЫ, ВЛИЯЮЩИЕ НА ИЗУЧЕНИЕ АНГЛИЙСКОГО ЯЗЫКА

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Abstract

Teaching English Language to children at an early age has positive impact. The researches have found out that there are some factors that affect the acquisition of a foreign language. The study investigates the internal as well as the external factors that influence the acquisition of English language by high school students. To achieve its objectives, some different activities have been used to find out new styles to teach English language to the students. Findings show that age and motivation are the most important factors that affect the learning of a foreign language in spite of the fact that there are some other factors that affect the learning process. The study presents detailed information about the factors that influence the acquisition of English Language by children.

Аннотация

Обучение английскому языку детей в раннем возрасте имеет положительный эффект. Исследования показали, что существуют некоторые факторы, влияющие на овладение иностранным языком. В исследовании изучаются как внутренние, так и внешние факторы, влияющие на овладение английским языком старшеклассниками. Для достижения поставленных целей были использованы различные виды деятельности по поиску новых стилей преподавания английского языка. Результаты показывают, что возраст и мотивация являются наиболее важными факторами, влияющими на изучение иностранного языка, несмотря на то, что существуют и другие важные факторы, влияющие на процесс обучения. В исследовании представлена подробная информация о факторах, влияющих на овладение детьми английским языком

Keywords: acquisition, foreign language, positive influence, factors, internal affect, external affect.

Ключевые слова: освоение, иностранный язык, положительное влияние, факторы, внутренний аффект, внешний аффект.

Язык – это, по сути, деятельность человека, направленная на общение с самим собой и другими. Необходимо помочь детям понимать как устную, так и письменную речь и выражать свои мысли различными способами. Язык является жизненно важным компонентом процесса обучения. На него влияют возможности и состояние пользователя, цель, для которой он предназначен, и ситуация, в которой он используется.

Все дети имеют право на образование на своем родном языке. Это тот тип обучения, который обеспечивает наилучшие результаты. Но знание международного языка важно для каждой страны, если она хочет развиваться экономически, социально и политически и занять свое подобающее место в мире. Первый язык, который изучает ребенок, является родным, а все последующие языки, изучаемые ребенком, считаются иностранными.

Некоторые студенты изучают новый язык быстрее и легче, чем другие. Существуют решающие факторы, влияющие на успех, которые в значительной степени находятся вне контроля учащегося. Эти факторы можно условно разделить на

внутренние и внешние. Именно их сложное взаимодействие определяет скорость и легкость изучения нового языка [1, с.18].

Большинство студентов не осознают важности изучения английского языка из-за унаследованных ими неверных представлений об изучении иностранного языка. Эти концепции могут вызвать непонимание важности основного универсального языка в глобальных транзакциях.

Английский является доминирующим языком, языком науки, который также рассматривается во всех странах мира как универсальный язык. Английский является наиболее распространенным языком в мире. Исследования показывают, что один человек из четырех может общаться на английском языке. Ввиду доминирования английского языка во всех сферах жизни, число желающих выучить английский язык увеличивается с каждым днем. Нет ни одной страны, в школах и университетах которой не преподавали бы английский язык.

В исследовании изучаются как внутренние, так и внешние факторы, влияющие на овладение ан-

глийским языком старшеклассниками. Для достижения своих целей были использованы различные виды деятельности по поиску новых стилей преподавания английского языка студентам. Результаты показывают, что возраст и мотивация являются важнейшими факторами, влияющими на изучение иностранного языка, несмотря на то, что существуют и другие важные факторы, влияющие на процесс обучения [3, с. 22].

Различные виды деятельности используются самым простым способом, чтобы помочь полюбить английский язык. Многие учащиеся склонны делать личный выбор и прилагают усилия, развивая свои способности изучать английский язык в школе. Учащиеся, естественно, хотят улучшить понимание языка и считают, что могут также улучшить свое знание языка посредством индивидуального обучения.

Но система образования в отношении учебной программы по иностранным языкам в нашем обществе проблематична, что заставляет студентов стремиться поступать в английские академические институты для развития своих языковых навыков.

Есть внутренние и внешние факторы, влияющие на успех учащихся в EFL. Целью данного исследования является изучение степени, в которой учащиеся способны усваивать иностранный язык, и каковы факторы, которые помогают им понимать язык. В данном исследовании упоминаются внутренние и внешние факторы, которые влияют на изучение учащимися английского языка.

Представлены соответствующие стратегии преподавания языка, которые интересуют студентов. Таким образом, цель исследования – изучить способность студентов овладевать английским языком и рассмотреть проблемы, с которыми они сталкиваются, а также изучить пути их решения. Изучение английского языка на самом деле является подсознательным процессом. У учащихся мало возможностей усваивать язык из окружающей среды без носителей английского языка. Является важными факторы, которые влияют на изучение детьми второго языка в зависимости от их возрастного периода в средней школе.

Внутренние факторы, влияющие на освоение английского языка

Изучение языка не происходит в результате передачи фактов о языке или серии упражнений на механическое запоминание. Это результат возможностей значимого взаимодействия с другими людьми на изучаемом языке. Таким образом, чтение лекций и декламация не являются наиболее подходящими способами использования языка на уроках второго языка. Учителям необходимо перейти к более широкому интерактивному использованию языка, например, в учебных беседах и совместной работе в классе.

Кроме того, он был определен как процесс, который объединяет когнитивные, эмоциональные и экологические влияния и опыт для приобретения, улучшения или внесения изменений в знания, навыки, ценности и мировоззрения. Заметим, что

общим местом между этими определениями является то, что обучение вызывает изменение поведения личности [4, с. 14].

Задача изучения второго иностранного языка гораздо сложнее, поскольку необходимо иметь всесторонние знания о поведении человека, о целях, которых вы хотите достичь возможным способом. На самом деле об изучении языка известно очень мало неопровержимых сведений, хотя существует множество устойчивых убеждений. Основными подходами к теории овладения языком являются психологический подход и лингвистический подход. Каждый подход оказал влияние на другой.

Таким образом, есть некоторые факторы, влияющие на успеваемость учащихся в изучении английского языка; внутренние факторы, такие как интеллект и восприятие, самооценка и стили обучения, и внешние факторы, такие как мотивация и социокультурный статус.

Следовательно, факторы, влияющие на овладение вторым/иностранном языком, подразделяются на внутренние и внешние. Внутренние факторы – это те, которые двуязычные изучающие язык привносят с собой в конкретную учебную ситуацию:

1. Интеллект. Способность ребенка освоить новые языки является одним из наиболее важных факторов, которые помогают ему получать много информации, особенно когда он получает информацию на ранних этапах жизни. Предыдущие исследования показали, что дети, говорящие на двух языках, умнее тех, кто говорит на одном языке.

2. Умственная зрелость. Считается одним из внутренних факторов, влияющих на овладение языком: умственные способности детей овладевать новым языком в возрасте 4 лет и старше выше, чем в любом другом возрасте. Практика языка с детьми в этом возрасте позволяет им лучше понять язык и обеспечивает умственную зрелость для быстрого овладения языком.

3. Возраст. Влияние возраста на овладение иностранным языком очень важно. Возраст обучающегося является одним из важных факторов, влияющих на процесс изучения иностранного языка. В более молодом возрасте способность овладевать языком становится более высокой и интуитивной.

4. Мотивация. Она проявляется в личности ребенка и в его мотивации к изучению языка. Если у студента сильная личность, он может изучать и овладевать новыми языками. Сильная личность поможет учащемуся быть более мотивированным.

Исследования, посвященные трудностям обучения учащихся, показали, что трудности в обучении учащихся были вызваны отсутствием врожденных или когнитивных способностей, нарушением восприятия и неспособностью к обучению, недостатками памяти или плохой мотивацией.

Большинство исследований сосредоточилось на этих фиксированных характеристиках студентов, которые наименее поддаются контролю. Школьные факторы оказывают большее влияние на достижения учащихся. В связи с этим возникает необходимость выяснения школьных факторов,

влияющих на обучение учащихся. Существуют некоторые направления и рекомендации по преподаванию английского языка на уровне средней школы.

1. Интервью. Метод интервью использовался для выяснения факторов, влияющих на изучение английского языка. Для проведения собеседования был разработан сценарий собеседования. Типы вопросов выбираются в соответствии с целями исследования, чтобы выявить факторы, влияющие на изучение английского языка. В программе собеседования есть открытые вопросы. Во время собеседования также задаются дополнительные вопросы с целью разъяснения.

2. Техника. Во время проведения интервью в исследовании использовалась техника «конспектирования». Поскольку участники не хотят, чтобы интервью записывалось, исследователь делает короткие записи и завершает запись после интервью. Собеседования проводятся индивидуально. Это часовое очное интервью, и участники готовы без напряжения и смущения поделиться своим опытом. Эволюция методологий преподавания привела к появлению инноваций в методах, подходах и техниках преподавания английского языка.

Внешние факторы, влияющие на усвоение английского языка

Существует множество различных внешних факторов, влияющих на овладение учащимися английским языком. Внешние факторы – это те факторы, которые характеризуют конкретную ситуацию изучения языка. Среди этих факторов — контекст обучения и преподавания, обучение второму языку и взаимодействие, то есть то, как эти элементы влияют на изучение языка.

Изучающие язык обычно знакомы с кинематическими играми и визуальным обучением. Учителя используют множество видов деятельности, таких как рисование, проектирование видимых действий и использование кинематических игр, которые играют роль в развитии способностей детей, изучать английский язык, а также приобретают более глубокую информацию, чтобы иметь лучшие языковые навыки [5, с. 34].

Возраст является одним из важных факторов, влияющих на процесс овладения вторым языком. Успешное овладение языком зависит от возраста обучающегося.

Существует определенный период в освоении второго языка. В этот период, который определяется как гипотеза критического периода в овладении языком. Овладение языком — это врожденный процесс, определяемый биологическими факторами, которые ограничивают критический период овладения языком примерно с двухлетнего возраста до полового созревания.

После латерализации, которая представляет собой процесс, посредством которого обе стороны мозга развивают специализированные функции, мозг теряет пластичность, и латерализация речевой функции обычно завершается к моменту полового созревания, что затрудняет овладение языком в постпубертатном возрасте.

Можно утверждать, что учащиеся в возрасте от 8 до 12 лет быстрее и эффективнее осваивают второй язык, чем младшие школьники. Молодым учащимся, начинающим изучать второй язык в возрасте от 4 до 7 лет, требуется гораздо больше времени, чтобы овладеть навыками, необходимыми для академических целей, чем учащимся старшего возраста. Причина, по которой учащиеся лучше усваивают языковые навыки, заключается в том, что дети, поступающие в школу в возрасте 5 или 6 лет, еще не полностью овладели своим первым языком.

Исследователи считают возраст, мотивацию, отношение и личностные факторы наиболее важными факторами, влияющими на овладение языком. Мотивация является одним из важных аспектов овладения вторым языком. Мотивация — это своего рода стремление к обучению. Очень сложно преподавать второй язык в учебной среде, если у учащегося нет желания изучать язык. Поэтому важно учитывать мотивацию изучения языка.

Мотивация может быть внутренней, внешней, интегративной или инструментальной. Эти факторы переплетаются с личностными переменными, такими как тревожность, интроверсия и экстраверсия, самооценка, готовность к риску, сочувствие и терпимость к двусмысленности. Однако разделять когнитивные и аффективные факторы несколько произвольно, поскольку на практике они во многом совпадают. [6, с. 28]

Такие факторы, как стили обучения, полезависимые стили, связанные с индуктивным, и полнезависимые стили, связанные с дедуктивным, связаны с теориями латерализации или функционирования левого/правого полушария мозга.

Другие внутренние факторы, которые также представляют собой различные типы факторов и играют важную роль в овладении английским языком, включают возраст, способности, мотивацию, отношение, личность, когнитивный стиль, специализацию полушария и стратегии обучения. Считается, что внутренние факторы являются ключом к овладению иностранным языком. Как упоминалось выше, возраст и мотивация являются наиболее важными внутренними факторами.

Успех в преподавании и изучении английского языка зависит от многих факторов. Факторы возраста и мотивации являются одними из наиболее важных, а также некоторых других факторов, влияющих на овладение вторым/иностраным языком. Более ранние исследования показали, что если учащийся владеет своим родным языком, он может совершенствоваться быстрее, чем те, кто не владеет своим родным языком. Что касается мотивации, то установлено, что мотивированные студенты более успешны в освоении иностранного языка, чем немотивированные. [7, с.40]

Учащиеся, которых учителя и родители постоянно поощряют к обучению, обычно добиваются лучших результатов, чем те, кто этого не делает. Например, учащиеся из семей, которые не придают большого значения изучению языка, скорее всего, будут прогрессировать медленнее.

Мотивация является движущей силой всех действий. Это необходимое условие обучения, как инициирующее, так и поддерживающее обучение. Мотивация может быть внутренней, исходящей изнутри обучающегося, или внешней, навязанной извне. Если мотивация внешняя, она станет эффективной.

Например, восторженное отношение учителя и положительные комментарии могут обеспечить внешнюю мотивацию для учащегося, чтобы он с энтузиазмом воспринял учебное мероприятие, но позже энтузиазм должен исходить от самого учащегося. Учащийся должен осознавать, что он учится получать знания для самоудовлетворения и самореализации, а не для того, чтобы получать похвалы и положительные отзывы.

Мотивация к изучению языка относится к степени, в которой человек готов стремиться овладеть языком из-за желания сделать это, а также из-за удовлетворения, испытываемого от этой деятельности. Бабаев Джавид подчеркивает: "The student will find the lesson very boring if the teacher does not stimulate or inspire him even if the topic is interesting" [2, p.83]. Это означает, что ученик найдет урок очень скучным, если учитель не будет его стимулировать или вдохновлять, даже если тема интересна.

Мотивация может быть глобальной, ситуативной или ориентированной на задачу, и все три в той или иной степени необходимы для изучения второго языка. Глобальная мотивация — это общая мотивация, в то время как в этом контексте ситуативная мотивация относится к изучению второго языка, а мотивация, ориентированная на задачу, относится к конкретной задаче по изучению языка. Мотивация имеет решающее значение для определения того, приступает ли учащийся к выполнению задачи, сколько энергии и усилий он готов потратить на нее, а также как долго он будет упорствовать.

Мотивация в изучении второго языка может быть интегративной или инструментальной. Оба являются внешними формами мотивации. Интегративная мотивация возникает, когда учащийся интересуется людьми и культурой второго языкового сообщества и желает общаться, тогда как инструментальная мотивация возникает, когда учащийся интересуется вторым языком как полезным инструментом для достижения своих целей. Например, получение квалификации, улучшение трудоустройства и т. д.

Для старшеклассников, изучающих иностранный язык, успеваемость в устной речи коррелировала с интегративной мотивацией, хотя в целом, но в одном из исследований, проведенных в Америке, интегративная мотивация не была значимым фактором. Оценки владения новым языком у учащихся с интегративной мотивацией были намного выше, чем у тех, кто был более инструментально мотивирован.

Чем более интегративно мотивирован ученик, тем чаще он добровольно давал информацию и тем чаще давался правильный ответ. Изучена связь

между интегративной мотивацией и приобретением владения вторым языком. Интегративная мотивация измерялась путем выявления предпочтений детей в отношении друзей, товарищей по играм и коллегам по работе.

Положительной связи между интегративной мотивацией и приобретением навыков не обнаружено. Дальнейшие сравнения между начинающими и продвинутыми студентами английского как второго языка показали значительно более интегративную ориентацию на целевую языковую группу у продвинутых студентов, чем у начинающих.

Интегративная мотивация следует за приобретением навыков второго языка, а не за их продвижением. Те, кто учился в течение пяти лет, имели значительно более высокий уровень позитивного отношения к изучаемому языку. Интегративная мотивация может отличаться у детей от взрослых, когда дело доходит до изучения второго языка. Английский изучается как международный язык, показали, что уровень инструментальной мотивации лучше всего коррелирует с успехом в изучении второго языка. Большинство учащихся мотивированы смесью интегративной и инструментальной мотивации.

Существует значительная положительная корреляция между возрастом чтения ученика и освоением английского языка как второго. Исследования показывают, что чем старше хронологический возраст учащихся средних школ, тем выше уровень языковых достижений. Поэтому вполне вероятно, что чем выше возраст чтения таких учащихся, тем выше уровень языковых достижений.

Отношение, мотивация и языковые способности являются важными факторами, влияющими на скорость овладения вторым языком. Люди с высоким уровнем языковых способностей лучше справляются с новым материалом по мере его подачи, в то время как люди с позитивным настроением и хорошей мотивацией будут работать усерднее, прилагая больше усилий для усвоения материала и проявляя больший интерес.

Различные показатели отношения и мотивации:

1. содержательно связаны друг с другом
2. относительно независимы от языковых способностей
3. связаны с показателями владения вторым языком.

Индекс суммирует основные аффективные переменные, предположительно участвующие в овладении вторым языком, включая:

- а) отношение к целевому сообществу
- б) интерес к иностранным языкам
- в) интенсивность мотивации или количество усилий, прилагаемых учащимся
- г) желание выучить изучаемый язык
- д) отношение к языку и оценка как курса, так и преподавателя
- е) интегративная направленность и инструментальная направленность.

Другие факторы включают роль формального обучения, климат в классе, факторы, связанные с работой учителей, время и возможность обучения.

Возраст и пол также являются факторами, равно как и социальная среда и роль родителей. Нет значимой положительной корреляции между самооценкой студентов и освоением английского языка как второго.

Очевидно, что изучающие второй язык, не имеющие широкого доступа к носителям языка, скорее всего, будут добиваться более медленного прогресса, особенно в устных/слуховых аспектах овладения языком. Хотя было проведено несколько исследований факторов, влияющих на овладение иностранным языком, мы попытались сосредоточить наше внимание на тех исследованиях, которые рассматривали внутренние и внешние факторы, которые помогают детям овладевать английским языком.

Не все внешние факторы были достигнуты учащимися. Однако есть и другие внешние факторы, которые были исследованы, а именно:

1. Учебная программа. Необходимость соответствия учебной программы детям в возрасте (4-6) лет заключается в том, чтобы дать им возможность получать как можно больше новой информации.

2. Мотивация. Этот фактор влияет на овладение вторым языком. Для студентов была создана хорошая атмосфера. Их поощряли и мотивировали, а их внимание привлекало сначала использование интересных способов, а затем раздача сладостей после каждого занятия. Вполне вероятно, что связь между мотивацией и достижениями носит интерактивный характер. Высокий уровень мотивации действительно стимулирует обучение.

3. Использование игр и визуального обучения. Учителя используют множество видов деятельности, таких как рисование и визуальные упражнения, а также используют игры, которые играют роль в развитии способности детей изучать английский язык, а также приобретают больше и более глубокую информацию для достижения наилучших результатов. языковые навыки. С другой стороны, внешними факторами, которые не были достигнуты в настоящем исследовании, являются:

4. Использование успешных образовательных программ. Этот фактор не был достигнут, поскольку, согласно комментариям учителей в анкете, не хватает средств для обучения детей различным навыкам английского языка, особенно оборудования, необходимого для аудирования и разговорной речи. Время, отведенное на курс английского языка, очень ограничено, поэтому преподаватели не могут одновременно охватить все занятия.

5. Доступ к носителям языка. В целом, в нашей стране нет носителей языка в качестве образцов для изучения языка. То есть не было прямого доступа к языку носителей языка. В наше время все идет к важному процессу овладения английским языком в связи с той важной ролью, которую приобретает этот язык. Есть некоторые критерии для изучения этого языка, такие как необходимость и мотивация, и если отнестись к ним серьезно, можно достичь очень высоких результатов.

Мы стараемся сделать все возможное, чтобы преподавать английский язык нашим ученикам, и на мотивацию учащихся и преподавание английского как иностранного языка с помощью стихов,

игр, рассказов и т. д. всегда должно влиять несколько факторов.

Можно провести различие между вторым языком, который выполняет социальные функции внутри сообщества, в котором он изучается, и иностранным языком, который изучается в первую очередь для контактов за пределами собственного сообщества. Когда дети учатся посредством второго языка, еще более важно, чтобы мы оказывали им максимально эффективную помощь, чтобы они могли понимать в меру своих способностей. Чем лучше мы понимаем факторы, влияющие на овладение вторым языком, тем более эффективной будет наша помощь.

Было проведено мало тщательно спланированных долгосрочных исследований факторов, влияющих на овладение иностранным языком в детстве и подростковом возрасте, а существующие исследования имели тенденцию концентрироваться на измерении владения языком и игнорировали возможности мотивационных факторов.

Кажется, существует общее мнение, что необходимы дополнительные исследования во всех областях овладения языком. Одна из проблемных областей, по-видимому, сосредоточена вокруг того, какие факторы влияют на овладение английским языком как вторым языком, и какой из этих факторов является наиболее важным. Таким образом, следующие три вопроса можно рассматривать как формальную постановку проблемы: Как происходит овладение языком, особенно вторым языком?

Методы преподавания и хорошие теоретические знания могут сделать учителя более подготовленным к вынесению здравых педагогических суждений. Теории обеспечивают основу общих принципов и предполагают, какие факторы или комбинации факторов способствуют успеху или неудаче изучающего второй язык. Цель исследования состоит в том, чтобы определить, как факторы, которые, согласно исследованию литературы, кажутся важными, влияют на овладение английским языком как вторым языком, и, во-вторых, определить наиболее важный фактор или факторы.

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USING THE PROJECT METHOD IN CHEMISTRY LESSONS

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ИСПОЛЬЗОВАНИЕ МЕТОДА ПРОЕКТОВ НА УРОКАХ ХИМИИ

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This article shows that to organize the research work of schoolchildren, teachers resort to the project methodology, as one of the effective methods of our time, based on the methodology of cooperation and problem-based learning that meets the requirements of a student-centered approach to teaching. In the process of such training, schoolchildren learn to think logically, scientifically, creatively, and experience confidence in their abilities. It is concluded that project activity contributes to the development of all types of universal educational actions of students (regulatory, communicative and cognitive), as well as a more comprehensive achievement of subject and personal results.

Аннотация

В данной статье показано, что для организации исследовательской работы школьников преподаватели прибегают к проектной методике, как одной из эффективных методик современности, основанной на методике сотрудничества и проблемного обучения отвечающей требованиям личностно-ориентированного подхода в обучении. В процессе такого обучения школьники учатся мыслить логически, научно, творчески, испытывают уверенность в своих возможностях. Сделан вывод о том, что проектная активность способствует выработке всех видов универсальных учебных действий обучающихся (регулятивных, коммуникативных и познавательных), а также более многостороннему достижению предметных и личностных результатов.

Keywords: experiment, analysis, result, observation, generalization, motivation, search, project method, chemical knowledge.

Ключевые слова: эксперимент, анализ, результат, наблюдение, обобщение, мотивация, поиск, метод проекта, химические знания.

В основе метода проектов лежит развитие познавательных навыков учащихся, умений самостоятельно конструировать свои знания и ориентироваться в информационном пространстве, развитие

критического мышления. Он направлен на самостоятельную деятельность учащихся – индивидуальную, парную, групповую, которую учащиеся выполняют в течение определенного отрезка времени. Метод предполагает решение какой-то проблемы.

А решение проблемы предусматривает, с одной стороны, использование совокупности разнообразных методов и средств обучения, а с другой стороны - необходимость интегрировать знания и умения из различных сфер науки, техники, технологии, творческих областей. В связи с этим популярностью в школьной образовательной сфере сегодня пользуется метод проектной деятельности.

Метод проектов - это комплексный обучающий метод, который позволяет индивидуализировать учебный процесс, дает возможность ученику проявить самостоятельность в планировании, организации и контроле своей деятельности и творчества при выполнении учебных заданий.

Современный этап развития нашего общества выдвигает особые требования к школьному образованию.

Целью метода научных проектов является воспитание активной, творческой личности, способной к саморазвитию, умеющей самостоятельно добывать знания, самостоятельно выбирать средства и способы решения различных задач. В связи с этим данный метод становится сегодня актуальной ведущей технологией школьной практики. Её главная идея заключается в следующем: с большим увлечением ребенком выполняется только та деятельность, которая выбрана им самим свободно, а деятельность строится не в русле учебного предмета. Новизна этой проблемы заключается в том, что в последнее время всё больше внимания уделяется практической направленности в химии, то есть к знаниям ведут через опыт, через практику. Также метод проектов, как отмечает М.С. Султанова, является выработка творческой личности ученика [1]. С помощью данной технологии ученики не только понимают, как смогут использовать добытые знания в будущем, но и учатся организовывать свою жизнь с их помощью сейчас на настоящем этапе.

Е.А. Вохменцева в своей статье подчёркивает, что проектная работа служит средством развития главных образовательных компетенций: ценностно-смысловой, общекультурной, учебно-познавательной, информационной, коммуникативной, социально-трудовой и компетенции личностного самосовершенствования [2].

В.С. Лазарев акцентирует внимание на значимости умений проектной деятельности, которые понадобятся и в прочих видах активности школьников: умение осуществлять анализ, ставить цели и формулировать гипотезы, планировать шаги для достижения цели, подбирать способы действий и работать в группе [3].

Е.С. Желанова также отмечает значимость умения осуществлять отбор информации и её структурирование, выступать с полученными результатами, проводить рефлексию [4]. Кроме того, метод проектов позволяет организовывать дифференцированное обучение, что иногда нелегко реализовать в рамках классно-урочной системы. Химия как наука, учебный предмет даёт больше возможности для организации такой деятельности, которая способствует развития интеллекта уча-

щихся, творческому подходу к собственной деятельности, к профессиональному самоопределению учащихся.

Научно-исследовательская работа в школе многоэтапная, содержит много компонентов. Для освоения навыков исследовательской работы на уроках химии основная часть идёт на лабораторный практикум, который является синтезом экспериментальной задачи, расчётной части и творческой работы в виде формирования научной гипотезы и выводов и отражает основные этапы научно-исследовательской деятельности.

Экспериментальная деятельность учащихся может быть связана, в первую очередь с исследованием конкретных объектов из повседневной жизни. При этом повышается осознанность знаний и проявляется интерес ученика к предмету. Исследовательская деятельность может вызвать затруднения у ученика, но это способствует большей самостоятельности, ученик старается решить данную проблему самостоятельно.

Познавательная активность учащихся вызвана в данном случае внутренней мотивацией, желанием найти неизвестное, что сопровождается положительным эмоциональным настроением.

Ниже представлены новые темы исследовательских проектов по химии 11 класс, которые подойдут для исследовательской деятельности учеников в старших классах. Самостоятельные занятия по химии в виде исследовательского проекта - это отличный шанс для дополнительной подготовки ученика к поступлению в ВУЗы.

Примерные темы исследовательских работ по химии для учащихся 11 классов:

Адсорбционная очистка сточных вод.

Анализ качественного состава жевательных резинок.

Анализ пищевых добавок в продуктах питания, их влияние на здоровье человека.

Биоразлагаемые полимеры — упаковка будущего.

Влияние бытовой химии на экологию и здоровье человека.

Вода — источник жизни и оздоровления людей.

Значение гидролиза солей в жизни человека.

Жизнь пластиковой бутылки.

Пути использования аминокислот в организме.

Радуга химических реакций.

Химия Земли и Космоса.

Представленные темы исследовательских работ по химии в 11 классе довольно интересны для учащихся старших классов, так как носят актуальный характер и подразумевают осуществление углубленного изучения материала, проведения интересных опытов и экспериментов с химическим оборудованием.

Многие перечисленные темы проектов по химии для 11 класса школы интересны в экспериментальной деятельности учащихся, могут выполняться как индивидуально, так и в группах под руководством преподавателя химии и с соблюдением требований охраны труда.

Разберем, как применить метод проектов на уроках химии. Учащиеся одного класса объединяются в группы и между ними распределяются темы. Задания раздаются заранее. Обсуждается план работы, учитель дает полную инструкцию по оформлению работы. В течение 10 дней ребята подбирают материал, создают содержательную презентацию. Сама работа распечатывается в виде реферата. А защита самого проекта происходит на уроке, исходя из всех современных требований к научным проектам. Ребята подбирают интересные видеоролики или же они их создают самостоятельно. На каждом уроке происходит защита определенного проекта. Ребята с большим интересом заслушивают друг друга, задают вопросы, подают свежие идеи. Они обобщают материал, подводят итоги, анализируют ответы одноклассников. В результате такой работы

с учащимися у меня накапливается электронный материал с презентациями и видеороликами по разделам химии. Ребята в свою очередь получают навыки самостоятельной работы по подготовке определенного материала, раскрывается их творческий потенциал. Идет сначала подготовительная работа с учащимися. Теоретический материал оформляется как мини научная работа с обозначением целей, актуальности, задач, ожидаемых результатов

Для определения пути мотивации учащихся к изучению предмета химии в школе было проведено анкетирование среди учащихся старших классов: в анкете имелся вопрос: «Какую форму работы вы предпочитаете на уроках «Химии»?». Полученные результаты представлены на рисунке 1.



Рисунок 1- Результаты анкетирования

Из рисунка 1 видно, что 30% учащихся предпочитают пассивную роль в изучении предмета (слушать объяснения учителя), а 70% выбрали более активную роль (решать творческие задачи, выступать с докладом, решать задачи, выполнять практические и лабораторные работы, выполнять тестовые задания).

Вышесказанное, позволяет сделать вывод о том, что использование в учебно- воспитательном процессе научно-исследовательского подхода в обучения является одним из важнейших направлений повышения мотивации, познавательного интереса к изучению предмета и повышению успеваемости учащихся.

Внедрение метода проектов в учебный процесс требовало наличия у учащихся навыков самостоятельной работы, самоанализа, самооценки. Большинство учащихся имели недостаточный уровень развития данных навыков. Именно поэтому, положительное восприятие идеи создания проекта, в соответствии с рисунком 2, было отмечено у 70% учащихся, но довести проект до логического совер-

шенствования смогли только 15 % процентов учащихся. Повышение активности учащихся на уроках методами проектной технологии при первоначальном анализе достигало только 50%, а осознанный выбор большинством учащихся данного метода для учебной деятельности всего 15%. После проведения исследования результаты данных критериев увеличилось до 65% и 25% соответственно. Что указывает на довольно медленное формирование волевых качеств.

Несмотря на невысокие проценты многих критериев, критерий продуктивности данного метода для формирования навыков саморазвития достиг 96% у учащихся, которые осознанно выбрали данный метод для учебной деятельности и готовы были своё свободное внеурочное время посвятить решению химических проблем. Количество учащихся, осознанно включившихся в проектную деятельность в ходе исследования, возросло на 10%. Следовательно, методы проектной технологии необходимо внедрять в практику, особенно, для учащихся с сильной мотивацией обучения.

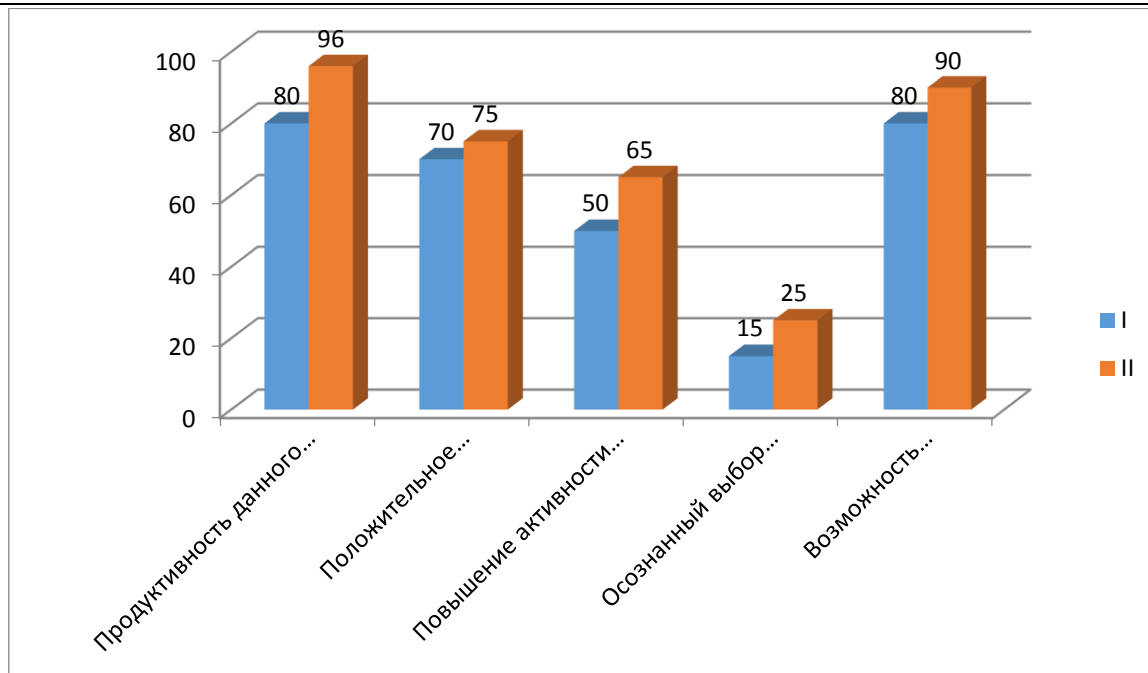


Рисунок 2. Сравнительный анализ критериев методов проектной технологии

Анализируя, опыт кафедры «Химия», мы можем сделать следующие выводы:

- проектная работа способствует повышению интереса к химии;
- у обучающихся есть мотивация к получению хорошего и прочного образования;
- формируются возможности проекта;
- обучающиеся начинают активно участвовать в различных конкурсах и конференциях.

Таким образом, проектная деятельность способствует формированию нового типа обучающегося, имеющего опыт самообразования, приобретающего навыки и умения самостоятельной работы, готового к сотрудничеству и взаимодействию.

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PHILOLOGICAL SCIENCES

SOCIAL AND RELIGIOUS-POLITICAL ENVIRONMENT IN THE PERIOD OF MUTANABBI'S LIFE

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Abstract

Abu-al-Tayyab Ahmad bin Husain known as Al-Mutanabbi is a very famous Arabic poet from the Abbasid period. He was born in 915 AD in Kufa, Iraq and died in 965 AD. He was the court poet of Saif-al-Daulah of Aleppo for whom he composed most of his poems. This is Mutanabbi whose poems keep Saif-al-Daulah alive in the history of the Arab world. Al-Mutanabbi composed his best poems for him. Al-Mutanabbi is one the greatest, most prominent and influential poets of Arabic language. His poetry has been translated into several important languages of the world. Although his poetry largely comprises the odes in praise of the kings, viziers, and governors he visited during his lifetime, his greatness lies in his sharp intelligence and wittiness. He was very talented and a genius. In his poetry he has discussed topics of philosophy of life, the courage which was so favourite to Arab poets, and the description of battles. When he used to write satires, it would be very painful for the person it was intended for. One of the best examples of this type of poetry is a satirical poem which he composed in the satire of Kafur Ikshidi, the king of Egypt. He uses beautiful similes and metaphors in his poetry. Al-Mutanabbi is one of the very popular poets of Arabic and his poems are still widely popular in the Arab world.

Keywords: Al-Mutanabbi, religion, politics, religious views, arab poetry, poet, poetry

Al-Mutanabbi, who is considered one of the leading poets of classical Arabic literature (the poet's full name is Abu al-Tayyib al-Mutanabbi Ahmad ibn al-Huseyn ibn al-Hasan ibn Abd al-Samad al-Jufi al-Kindi al-Kufi - J.A.). m. He was born in 915 in a poor family in al-Kinda neighborhood of Kufa city. His father was a water carrier. Al-Mutanabbi's upbringing in a center of science and culture like Kufa played a major role in his formation as a comprehensive personality and a wise person. The poet received his first education right here - in Kufa, in the madrasa taught by Shiite scholars. Most medieval researchers report that al-Mutanabbi wrote poetry from childhood and had a wonderful speech. The life and work of Mutanabbi, who is considered a great representative of classical Arabic poetry, coincides with the third stage of Arabic literature characterized as the period of stabilization of literary synthesis traditions during the Abbasid period (750-1258).

Mutanabbi's entire life coincided with an environment of internal and external political strife, and the turbulent environment did not leave an impact on the poet's creativity. As for Al-Mutanabbi's religious and political views, different and even contradictory opinions are expressed in the sources. Opinions surrounding his arrest are radically different. Some claim that he was arrested because he led a popular uprising for his political actions, while others claim that he was arrested because of his claim to be a prophet.

Al-Badi, the author of a tazkirah, which is the source of the most wrong ideas about Al-Mutanabbi, narrates the words of Abu Abdullah Muaz ibn Ismail, who lived at that time: "Abu al-Tayyib h. He was still

young when he came to Lazigiya (Latakia, a city in Syria – J.A) in 320 AD (932 J.A). When I got acquainted with his beautiful eloquence and eloquence, I welcomed him with a treat. I wanted to sit in a corner and listen to his impressions of the places where he was, to get to know his literature and knowledge more closely. I said to him: "You are a virtuous and dignified young man who has managed to associate with great and powerful rulers and win their patronage!" - I greeted with the words. But as soon as I finished speaking, he answered me in a bitter way: "Woe to you, do you realize what you are saying, do you know what you are talking about? I am chosen, my messenger"... Having said this, he recited his "Quran" consisting of 114 surahs by heart and performed a miracle to prove his prophethood..." [1, p. 28]. Khatib al-Baghdadi, another tazkirahist, points to this in his work entitled "Tarikh" and writes in his own language what al-Tanukhin told his father, Abu Ali ibn Abu Hamid: was". Most likely, the words called "verses" by the people of Aleppo and presented as "Al-Mutanabbi's Qur'an" in some source studies are saj (in classical literature, the weight of poetry determined by the precise anticipation of the sequence of long and short syllables in certain combinations that creates a beautiful reading rhythm in all verses - J.A.) is nothing but a sermon in the form. Whether they really belong to al-Mutanabbi or not is doubtful." Continuing after that, Abu Abdullah claims that al-Mutanabbi invited him to the desert and was able to stop the rain for a while and convinced those who witnessed this event that he was the Messenger of God. I.M. Filshinsky reports that such miracles are often performed by the Bedouins of

Yemen and that they use seven special spells for this [2, p.30].

Another researcher, Hasan al-Zayyat, who said that al-Mutanabbi made prophetic claims, claims that this event took place in 321 AH (933 AD) and to confirm what he said, he refers to such a narration circulating in languages at that time: "Allegedly, Abu al-Tayyib was asked about Prophet Muhammad (s.a.s), the poet replied: "He is a human race who brought news of my prophethood", - "There is no prophet after me." I am called "la" in the heavens. Most likely, the author took this wrong information from "Subh al-Munabbi". Al-Samani, one of the medieval authors, narrates the above-mentioned: "In the desert of Abu al-Tayyib al-Samawa, gathering around him a large number of supporters from Banu Kalb, Banu Kilab, Banu Saba (Saba) and other neighboring tribes, he first established himself as an Alawite, then the prophet announced. But very soon the people of Damascus saw the lies in his calls and claims, and sent a message to the Emir of Homs, al-Lulu ibn Ali al-Hashimi. The emir attacked al-Mutanabbi's group with his troops, killed many of his associates and exiled the rest. He sentenced Abu al-Tayyib to a long prison term. Al-Mutanabbi, who was under the personal control of al-Lulu, was released only after he signed a written document and admitted that he was wrong in his claim of prophethood and repented and returned to Islam" [3, p.506]. Al-Badi, confirming what al-Samani said, says that after the rumor about the poet's prophethood spread to the world, ibn Ali al-Hashimi arrested him in a village called Kutak and put shackles of willow on his neck. Al-Mutanabbi points to this in his ode and says:

"The governor of Kutak informed me that he is a descendant of Hashim ibn Abd Manaf. I answered him: "From the day you came from their descendants, their shackles were made of willow" (translated by J.A.).

Al-Askilani cites Ali ibn Mansur's letter to Abu Ala al-Ma'ari as the main source that proves the authenticity of this fact. The letter contains the following information: "Al-Mutanabbi was arrested and imprisoned during the reign of Ali ibn Isa." Abu al-Tayyib, who was brought before the ruler, confessed that he declared himself a prophet, and for that he was given fifty lashes. Al-Askilani mentions in his work the dialogue of Ghazi ibn Umm al-Shaybani with al-Mutanabbi as confirmation of what Ali ibn Mansur said. It is said that one day when Sheikh Abu al-Tayyib was asked about the meaning of his nickname, he related it to an insignificant, not very important event, but he did not want to reveal the reason because he was ashamed.

Giorgi Zeidan, a scholar of classical period Arabic literature and Islamic history, attributes al-Mutanabbi's arrest to political motives. The author says that when he was still a teenager (at the age of 17-18 - J.A.), he claimed to be a judge and gathered many supporters around him. Another researcher, Hasan al-Zayyat, says that the ambitious young man attracted people around him with his excellent oratorical skills, eloquent speeches and the magic of his sermons. Another author, Abu Nasr Abdul Malik al-Saalibi, also expresses this opinion. According to the witnesses, the young poet

finds fame so quickly that the ruling circles are worried about it. Not long after, the governor succeeded in arresting the young poet Ahmed. But the poet, taking refuge in the governor's mercy, sent him the following ode along with the letter: "I turn to you in despair. Death is as close to me as my coronary artery. I am begging you. Because trouble has already overwhelmed me. My knees do not bend from the weight of the iron (handcuffs - J.A.)."[4].

Complaining that the handcuffs were too heavy for a young man like him and that he could not prostrate while praying, al-Mutanabbi begged the governor for forgiveness. However, as soon as he is freed, the arrogant poet not only abandons his political ideas, but even goes further, claims to be an Alawite, and then to be a prophet, and calls people to believe in him. Hassan al-Zayyat and George Zeidan claim that al-Mutanabbi was arrested twice. However, it is not indicated in other investigated sources. The only source is a collection of articles about al-Mutanabbi, where it is shown that after his return to Kufa, he participated in the uprising against the government and called the people to fight for their desires, as well as being arrested for being an Alawite. Most likely, al-Mutanabbi was among those arrested during the suppression of the rebellion. If we refer to this assumption, the fact that he was arrested twice is justified. It should be noted that most researchers confirm the fact that al-Mutanabbi was arrested for his political actions and for leading the popular uprising. Sources date this event to about h. They indicate that it happened in the years 323-324 (AD 934-935 - J.A) with the date (4). While the poet was still in Lazigiya, the German researcher Blasher together with the people of al-Samawa desert m. He says that in 932 he took part in the Qarmati rebellion against the country's government, but the rebellion was suppressed very soon and al-Mutanabbi was arrested along with other participants. This fact is confirmed by Carl Brokelman, Wen Chin Ouyang, Omar Farrukh, Martin Nick and others. Ahmed Subhi al-Mutanabbi confirms that he received his nickname "as a memory of his life as a prisoner."

Al-Mutanabbi's Arab self-esteem and Arab bigotry were already formed at a young age. The pride and arrogance typical of real Arabs of the patriotic poet, who did not want to come to terms with the domination of the Persians over the Arabs and the presence of non-Arabs in power, came from here. Omar Farrukh narrates the arrest of the poet as follows: "Al-Mutanabbi's rebellious speech, who gathered the people near Homs and called them to refuse to pay taxes, soon reached the governor and he arrested the poet. Abu al-Tayyib received the nickname "Mutanabbi" after that. Shauqi states that the rebellion in which Dayf al-Mutanabbi participated was not a religious or a Qarmatian rebellion, as some researchers claim, but a purely political and popular rebellion. According to him, this event h. It happened at the end of the year 321 (around AD 933 - J.A). At that time, Abu al-Tayyib was not yet 20 years old. The poet, who did not hide his regret in the face of the disgrace and humiliation of his time, said: "I am the one with my help God explains the dignity of people", most likely

he tried to describe himself not as a prophet, but as an imam calling people to the right path. In this regard, one cannot disagree with the opinions of Abu Ala al-Maari, al-Ukbari, Khatib al-Baghdadi, ibn al-Anbari and other researchers. Authors who explain al-Mutanabbi's prophetic claims from a political point of view associate it with the poet's patriotism. It is no coincidence that Ibn al-Asir, who is considered the author of valuable works on the history of Islam, does not mention him among those who declared himself a prophet.

As for false prophecy in the history of Islam, its roots go back to the early years of Islam. As is known, in the seventh century in Arabia, Hazrat Along with Muhammad (pbuh), many others declared themselves prophets. Musaylim, the head of the Hanifa tribe in Yemen, Sajjah from the Tamim tribe, al-Aswad from the Khubban valley, Ibn Sayyad of Jewish origin in Medina, and others declared themselves the prophets of their time [5, p. 34]. Sources contain some information about them, albeit very little. Most of them lived during the time of Prophet Muhammad (s.a.v) and their political activities were led by Hazrat. They started near the end of the life of the prophet Muhammad (s.a.v). However, these people started their preaching activities as clergy much earlier. There are certain reasons for false prophecy and the fact that these prophets are mostly poets. As is known, words, poetry and poetry have a great value in Arab culture. In Arab culture, poets were held in high esteem, and their eloquence was even considered the strength of the tribe they belonged to. It is no coincidence that during the war, before the battle, the Arabs used to exchange words and exchange poems on the battlefield. These poems in the Rajaz genre were recited by a poet representative of the tribe or a warrior with a talent for poetry. And sometimes it happened that the winner of the competition of poetry and words was declared the winner of the battle without fighting. The poets who have special respect in Arabic literature have a place in the society and have influence due to their fame. It was precisely for this reason that God Almighty They claimed that the Messenger of God was a poet, likening the "Holy Qur'an" revealed to Prophet Muhammad (s.a.v) to a poem due to the rhythmic and harmonious language. Surahs and verses were revealed by Allah for the rejection of these claims. Thus, several verses of "Shu'ara" surah and "Ya sin" surah of "Quran-Karim" were revealed to prove that Prophet Muhammad (s.a.v) was a poet and what he said was not poetry.

It is likely that al-Mutanabbi's leadership of the people's uprising and raising his followers against the non-Arab authorities made people believe in his prophethood. On the other hand, Abu al-Tayyib's eloquent words in the form of his claims to be a judge and the declaration of himself as a judge who would unite all Arabs under a single administration made people believe that his sermons and speeches were extraordinary and magical. Emirs and caliphs were considered God's messengers on earth, his representatives. Perhaps it is for this reason that young Abu al-Tayyib's claims to judgeship earned him the nickname "Mutanabbi" (the one who pretends to be a

prophet - J.A.). It is no coincidence that Western authors explain this nickname of the poet not as "one who pretends to be a prophet", but as "who wants to be a prophet", "aspires to be a prophet". If we take into account that the unusualness is characteristic only of prophets, we can understand that it is no coincidence that the people call his sermons verses of the Koran, and himself a prophet. This point of view is consistent with what Ibn Jinni, al-Andalusi, Muzaffar al-Tabsi and others have said, who defend the idea that al-Mutanabbi declared himself a prophet in poetry. This can be explained by al-Mutanabbi's "game of prophecy" simply because he wanted to give his words and poems divinity and eternity. It is no coincidence that al-Mutanabbi himself said that he was sent to poets as a prophet and that his miracles were verses. Referring to the poet's contemporaries, Ibn Rashiq al-Qairavani states that Abu al-Tayyib said "I first prophesied in poetry..." [6, p.34]. Abul Qasim Muzaffar al-Tabsi, the author of one of the famous eulogies written on the death of al-Mutanabbi, says: "He declared himself a prophet in poetry, but his miracles were revealed in meanings."

Abu Muhammad Abdul Jalil ibn Wahab(un) al-Andalusi, one of the prominent representatives of classical Arabic-Spanish literature: "It is not surprising that he declared himself a prophet in poetry. I wish he knew that you are reciting his poem to raise your name and to be proud of others", he confirms the above opinion. Al-Saalibi also expresses the opinion that al-Mutanabbi's powerful eloquence and eloquence, the magic of his words made people believe in his extraordinariness and attracted them to him.

True, there are many who are sure that he got this nickname because of his excessive arrogance and desire to have great virtue, because he was not satisfied with the fame he achieved in the field of poetry, and because he aspired to the mastery achieved by victory. However, Joseph Hashim, one of the well-known researchers of classical Arabic literature, disagrees with these statements. According to him, this person, who has a beautiful speaking ability and a pure and fragile heart, was elevated by the age itself and made him the greatest genius of his age. Al-Mutanabbi's inner fire, crazy poetic nature sometimes forced him to praise undeserving people, which the poet figuratively expressed as "selling poetry in the market where cynicism prevails". At-Tabsi did not exaggerate at all when he said: "His personality has a supreme majesty, and his arrogance is typical of sultans." We think that none of the narrations spread about al-Mutanabbi's prophethood are nothing more than hearsay and gossip, not based on substantial evidence or proof. Al-Mutanabbi: "The whole universe is the narrator of my poems. If I say a poem, time itself will begin to repeat it" "Even the deaf hear my words, even the blind see my manners", "The horse, the night, the desert know me, the battle, the blow, the paper and the pen are familiar to me (my power)" - In fact, the verses in the form are nothing but a self-affirmation sign of an arrogant poet's genius, who is constantly faced with sarcasm and mockery due to his origin, a debased person burning with the desire for heroism [7, p.550].

It should be noted that al-Mutanabbi considered himself innocent and explained his arrest as the betrayal of the Jews:

"My place in the land of Nakhla is like the place of Prophet Jesus among the Jews. I live in such a nation that - may God himself punish them! - Just as the righteous prophet was a stranger among the people of Thamud, so I am a stranger" [8, p.71]. It is worth noting here that this verse is based on the poetic figure of talmih. Here, verses 11, 12, 14 and 15 of Surah al-Shams of the Holy Quran are pointed out: "Thamud (his people) rejected (Prophet Saleh) because of their perversion. When the most despicable of them got up (to kill the camel that God brought out of the rock as a miracle), the Prophet of God said to them: "Do not touch this she-camel of God, do not prevent her from drinking water!" But they considered Saleh a liar and caught the camel and slaughtered it. Because of these sins, God cut off their roots and destroyed them..." (Sura al-Shams, verses: 11-12, 14-15).

In this poem, Al-Mutanabbi compares his situation with Prophet Jesus, who appeared among the Jews, and Prophet Saleh, who was sent as a messenger to the people of Thamud. The poet says that he, like Jesus and Prophet Salih, was exposed to the body of people and was branded as a liar. Most likely, Jews did not play a positive role in the life of the poet. Joseph Hashim also confirms that Al-Mutanabbi's arrest was the result of political reporting and that Jewish priests were involved in this case. Al-Badi'i states that the poet alludes to this in several places of his divan. Let's take a look at a part of his ode dedicated to the governor:

"O merciful emir! I am a poor stranger standing in front of you with my hands tied. A stranger whose mother sheds bloody tears when she remembers. If I have done wrong before I met you, I repent before you now. They gossip about me and try to slander me. I am a victim of these gossips and lies. My detractors are trying to portray me to you as a person with many flaws and defects."

It is no coincidence that in one of the gatherings organized near Hamdani ruler Seif al-Dawla, he asked the poet: "Is it true that they call you Ahmad al-Nabawi?" - when asked, Abu al-Tayyib stated that it was a fabrication of his villains who tried to defame him [9, p.221]. Ibn Jinni also confirms this fact. According to him, the villains who informed the ruler about the poet claimed that Abu al-Tayyib had gathered a large number of people around him, and his goal was to seize the territories under the ruler's control and power. This was the main reason for Al-Mutanabbi's arrest.

Abu Ala al-Maari claims that what is said about this is exaggerated, and explains al-Mutanabbi's prophecy from the concept that "all geniuses have quirks." There was no doubt that he was unusual. Most likely, the poet had extraordinary strength. It was said that while he was in Lazigiya, he healed the wound with mouthwash and even raised the dead. On the other hand, al-Mutanabbi's powerful eloquence and eloquence, the magic of his words convinced people of his unusualness and attracted them to him. Since the age of ignorance, there have been various beliefs about

poets having extraordinary power and the magic inherent in their poems. The German researcher Nöldek states that the poet of the period of ignorance was the prophet of his tribe, its leader in peacetime, and a knight-hero during war. I. Goldtsiyyer confidently says that the term "shair" meant not only "poet" but also "seer" (priest - J.A.) at that time [10, p.149]. In the Arabic language, the root of the word "poet" is the verb "shaara", which means to hear and feel. It was not accidental that the owners of the pen were named in this way. The ancient Arabs often meant feeling supernatural forces by this word. According to the famous Arab philologist ibn Rashiyy al-Qairavani, the poet got this name because he heard and felt what ordinary people did not know. In general, quirks are characteristic of all poets. The Arabs, who believed that the owner of the poems recited with a certain melody and rhyme were inspired and dictated by supernatural forces, believed that the poets also had extraordinary powers like priests, and even believed that they had a connection with demons. The metaphysical approach to poetry and the art of words, the sounding of rhyming poetic pieces as mystical prayers, introduced poets as a class with extraordinary power, like priests and diviners. The German poet Heyne expressed this idea in one of his works: "Man is the most magnificent and supreme of all living beings. And the poet is the most chosen and the highest of the human community" [11, p.13].

Prof. Aida Gasimova touches on this topic in her article "Attitude of Jahiliyat Arabs to poets and orators" and characterizes the unusual nature of the creative process and its connection with supernatural forces as an unusual case that often occurs in human history [13, p.17]. . Mendeleev, a famous Russian scientist, discovered the periodic system of elements in a dream, Walter Scott wrote "Ayvego" while unconscious, Italian composer G. Tartini claimed to have heard the famous sonata dedicated to the Devil, Ibn Sina was informed of the solution of many scientific issues in a dream. and his warning of future events in some of his poems [for example, in one poem he warned of the Mongol-Tatar campaigns and their disaster] can be considered a manifestation of this mystical connection. The Russian orientalist I. Y. Krachkovsky was the first to refute the opinions of some researchers who put forward the idea that Al-Mutanabbi claimed to be a prophet. Referring to older and more reliable sources, the critic came to the conclusion that the poet's activity was not religious, but political in nature, and the connection of his name with the root "أَنْب" was the result of public fabrication. Academician I.Y. Krachkovskii mostly refers to Abu Ali al-Farisi, a contemporary of al-Mutanabbi, in his assumptions. The researcher states that the author approaches this fact very cautiously and narrates the incident as "we have heard that they narrate like this in Aleppo". Blasher, Carl Brokelman, Shawqi Dayf, al-Isfahani, Joseph Hashim, Ahmad Tabbel, Ronald Nicholson, Omar Farrukh, Martin Nick and others also agreed with academician I. Y. Krachkovsky and stated that the words said about al-Mutanabbi's prophecy are not based on truth. . I.Y. Krachkovski believes that the

legends and fictions related to the poet's prophecy appeared due to his poetic use of the names of faith and prophet in his poems. Al-Saalibi, the author of "Yatimatu-d-dahr", referring to ibn al-Jinni, one of the first commentators of al-Mutanabbi's divan and a contemporary of the poet, states that al-Mutanabbi got his nickname because of the poem "My place in the land of Nakhla...". Let's take into account that the poet claimed that this pseudonym was attached to him in his ode, and that what was said about his prophethood was nothing but a rumor [12, p.16].

As for the totality of all the obtained information, it is possible to conclude that Mutanabbi's creativity was greatly influenced by his political views. The poet, who was known for his harsh speeches against the ruling circles of his time, also had rapprochements with various ruling forces from time to time. This is evident from the praise poems he wrote to some statesmen who lived at that time. But in general, the main line of Mutanabbi's creativity is the challenge against injustice, rebellion, and subjugation. Regarding Mutanabbi's prophethood issue, based on the information in the sources, we think that he never made such a claim. But we can say with certainty that Mutanabbi is truly the prophet of classical Arabic poetry.

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RELIGIOUS METAPHORS IN ARTISTIC DISCOURSE

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РЕЛИГИОЗНЫЕ МЕТАФОРЫ В ХУДОЖЕСТВЕННОМ ДИСКУРСЕ

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Metaphor functions differ from each other in terms of productivity, and some functions are somewhat difficult to explain. Metaphors have an emotional-expressive effect on the addressee, they evoke an emotional evaluation reaction. When religious metaphors are used in artistic discourse, the emotional-expressive effect is strengthened. Religious sacredness increases the effectiveness of the metaphor. Metaphors are one of the stylistic features of fiction. Its text creation function is related to explanation and interpretation, explanation with additional sentences.

Аннотация

Метафорические функции отличаются друг от друга по продуктивности, а некоторые функции несколько сложно объяснить. Метафоры оказывают эмоционально-экспрессивное воздействие на адресата, вызывают эмоционально-оценочную реакцию. При использовании религиозных метафор в художественном дискурсе усиливается эмоционально-экспрессивный эффект. Религиозная святость повышает эффективность метафоры. Метафоры – одна из стилистических особенностей художественной литературы. Его функция создания текста связана с объяснением и интерпретацией, объяснением с помощью дополнительных предложений.

Keywords : metaphor, religious, discourse, concept, cognitive metaphor**Ключевые слова:** метафора, религиозный, дискурс, концепция, когнитивная метафора

A literary text is a text created by a writer or an author. In a fictional work, the author talks about real events or invents something himself and tries to present it as a real event. The product of mental and emotional perception in the literary text is based on the imagination and thought of the author, associatively it is directed to the religious and mythological discourse. Artistic discourse is a communicatively oriented verbal work with aesthetic value formed in the process of perception and understanding. A literary text is written for the reader and rooted in his comprehension. The addressee of the literary text is the reader. Such texts can be written on various topics. It is possible to consider artistic works written on religious topics as artistic religious discourses.

The development of religious metaphors in the literary text is also a specific key to the figurative understanding of this text by the addressee. The division of texts into different types, the presence of specific characteristics of each of these types forms a certain structural and semantic system of norms for separate groups of texts, including literary texts. Accepted norms prevent to violate the correctness of the text, put it in a certain framework. However, it is typical for a literary text to exceed the limits of the norm, and this affects the nature of the organization of utterances. Religious texts and literary texts with religious themes are different concepts. The processing of metaphor in the text does

not directly depend on the genre differences of the literary text and the text in general. Of course, religious metaphors appear mostly in texts with religious themes.

In modern science, the question of conceptual or cognitive metaphor is posed. Conceptual metaphors are based on a certain concept. In the process of understanding, a person thinks and makes judgments not with the real objects and events themselves, but with the language signs that name and represent them. The religious lexicon and religious terms used in the text require the reader to have some background knowledge about religion.

There is an aesthetic specificity in the literary text, and this aspect is the main distinguishing feature of the literary text. Of course, in other types of texts - journalistic, scientific, etc. texts also have aesthetic value. The language of a literary text is distinguished from the language of other types of texts by its imagery, expressiveness, emotionality and expressiveness.

A genre is a group of works united by common features of content and form. Novel, short story, short story, poem, comedy, poem, etc. belongs to different genres. The concept of literary genre is also used in literary studies. Literary genre is a broad concept of genre. For example, the novel is a type of fiction, different types of novels (detective, historical, psychological novel, novel-fable, novel-anti-utopia, etc.) are considered genres.

The differences between the composition of poetry and prose works are based on the internal basis of

dividing the work into parts. Poetry is characterized by internal organization. Regarding the problem of thematic composition, it is appropriate to consider interrelated concepts such as theme, motive, plot. During the linguistic analysis of the lyrical work, the composition, as well as the role of some tools in text creation, the development features of the subject are taken into account. Metaphors, including metaphors, are widely used in poetic texts. Theme and motive are such semantic units. A work of fiction not only carries information, it has an aesthetic effect on the reader due to the special arrangement of word material.

When classifying text according to stylistic features, the names of text types used in the corresponding style are used. For example, reportage, interview, news texts are journalistic style texts. When the text is treated as a unit of communicative act, the function and form of the text according to the speaker and the listener are taken as the basis for determining its types. Among the criteria selected during the classification, informativeness, functionality, structural-semiotic and communicative features of the text are highlighted. In general, it is possible to approach the issue of text classification from at least four directions. The first direction is the functional typology of texts. At this time, the social function of the text and the fields of development act as a criterion. The second direction is the classification of the text according to its structure. At this time, the internal elements that make up the text are the basis of the criterion. The third direction is related to stylistic classification, and here too the sphere of development, the field to which the text belongs is taken as an important element. Finally, the fourth direction covers the classification of the text according to communicative features. In the main classification divisions of the text, according to its topic and content, according to the extra and intra-text distinguishing features of the text (written-oral, spontaneous-non-spontaneous, monologic and dialogic, mono-addressee and poly-addressee, etc. .), according to intratextual signs (regularity of text structure construction), we are talking about the division into extratextual factors (real communication factors).

In the lyrics, rather than the description of the events themselves, it is about the emotions and feelings that their impact on the author evokes. Here the author's inner world, experiences, impressions, heartbeats are written. The lyrics are based on the feelings and emotions experienced by the author. In dramaturgy, the subject is described in action. The reader or viewer watches the events unfold. The author's speech is echoed in remarks and replicas of the characters. Thus, epic events, the fate of the heroes, their actions and deeds are narrated, and the external aspects of what happened are described. Here, the feelings and emotions of the characters are conveyed by their manifestation. The author has the opportunity to express a direct reaction to the happenings. In the drama, the event, the relationship between the heroes is described on the stage. The direct expression of the author's attitude is realized in the form of remarks.

Metaphorical structures are implicative in nature and are the product of emotional-expressive perception of objects, as well as creative approach to language

units. The creative approach is typical for the process of fictionalizing events. The need for a metaphorical understanding of reality is also closely related to human nature. In the creative process, a person analyzes new concepts, objects and objects based on his historical experience, tries to compare them with similar objects and events to one degree or another, and names them differently. Artistic creativity tends to present new images. Metaphor contributes to the increase and organization of human knowledge, observations, perceptual perception of objects of reality, as well as the study of the relationships between these objects from a new perspective.

In literary text, metaphor is the main means of creating expression. Metaphor as a psycholinguistic category helps reveal implicit textual meanings and becomes an integral part of the literary text.

At the basis of artistic creativity is the study of reality at the level of understanding and evaluation. The writer perceives reality in a unique, specific way, evaluates it and presents it to the reader. In the way he sees and perceives real events, the author filters his own attitude and intention, enriches it with aesthetic content, narrates it in a partially or completely modified way, using figurative language, artistic means of expression, either from his own language or from the language of his characters.

Artistic text is the basis of artistic discourse. The process of creation of artistic discourse has a certain different aspect compared to other types of discourse. Its creator is a writer or poet. In the artistic discourse, the communicative act has a specific feature. Communication is unidirectional. The process goes in the form of addressee → literary text → addressee. The second party's participation in the loss in action is not observed. From this point of view, the issue involves learning the features of metaphor development in the literary text.

In linguistics, the text is explained in different ways. Text is considered a sequence of verbal signs. Its organization should meet the requirements of textuality. Textuality implies the implementation of external relations, internal completeness, necessary conditions of communication, understanding of the text [9, p. 507]. The written interpretation of the text instills its signified nature. However, a text is not only a sequence of signs, but also a complete sign, the named and named. The name of the text is material, and its name is ideal [11, p.208]. It is called perception and imagination. The understanding of the text is ambiguous, subjective, and depends on the reader.

The communicative character of the text manifests itself in different forms. Communication is always between the addresser and the addressee. The difference is related to the change of addressee and addressee. As the text itself can be the addressee, and the reader can be the addressee, communication has the opportunity to be realized between the audience and cultural traditions. The text, especially the literary text, becomes the reader's communication with himself. These aspects depend on the text, its content, impact, and the reader. This or that text, especially the literary text, is closed because of the namer and infinite because of the named.

It is determined by the experience and knowledge of the named reader [11, p. 208].

In modern linguistics, literary text is considered from various aspects - semiotics, structure, communicative-pragmatic, etc. is studied in terms of In the artistic text, the national-cultural codes that reflect the cultural values gained through the works and reveal the national spirit play an important role.

At the same time, the work of art performs the function of communication between the addressee and the addressee. Therefore, it is important to study the literary text in the direction of addressee → literary text → addressee. Determining the relationship between the author and the narrator helps to determine who plays the role of the addressee in the communicative act. The author is the real history that created the work, and the narrator is the person invented by the author. Narrative text is formed from the text of the narrator and characters [3, p. 417]. In a number of works of art, there is an author's text in addition to narration and character texts. The main feature of a literary text is that the author creates all the texts that make up it (narrative, character and author's texts).

By realizing the addressee's intention, he expresses a certain goal and thereby creates a specific illocutionary influence [10, p. 296]. In order to reveal this power, it is necessary to reveal the intention of the addressee. Perlocution arises from the attitude of the addressee to the real result. It involves the recipient's reaction, interpretation and perception. Most of the time, the inconsistency of the comment and the uncertainty of the addressee's reaction are observed. This is due to the diversity of communicators' life experience, knowledge level, as well as many other factors.

The author who creates the literary text conveys information to the addressee, in this information he expresses his attitude to the events. When the addressee's intention and the addressee's perception coincide, illocution and perlocution are fulfilled, the pragmatic goal is realized, and communication is realized.

In the process of communication, as well as creativity, the speaker can give a word a meaning that differs from its general meaning. It is related to the speaker's communicative intention or imagery. The use of metaphors in a literary text is one such phenomenon.

Personal and linguistic metaphors are used in the literary text. Such metaphors are involved in research from the point of view of functionality, processing in different genres of literary texts, and coding and decoding of author's metaphors.

Author metaphors are divided into unique and unstable metaphors. Uniqueness is manifested in the fact that the author reveals the connection between two events or objects in the creative process.

15 functions of metaphor – 1) nominative; 2) informative; 3) mnemonic; 4) style; 5) text organizer; 6) genre making; 7) heuristic; 8) explanatory; 9) emotional evaluation; 10) ethical; 11) autosuggestive; 12) coder; 13) concealment; 14) game; 15) the presence of ritual functions was noted. Of course, these functions are closely related to each other.

Metaphor is used in various genres of literary texts. V. K. Kharchenko talked about the genre-creating

function of metaphor. In our opinion, the fact that metaphor is used in various genres of fiction does not justify its acceptance as a means of genre creation. Because the artistic genre exists regardless of whether the metaphor is used in the work written in this genre. When defining the genre, metaphor does not play the role of a distinguishing feature. In general, defining the functions of metaphor, including religious metaphors, requires the general principle of metaphorization.

M. Blake explained the general principle of metaphorization in his interactional theory. According to him, four elements are involved in the metaphorization process. The first element is the focus of the metaphor. The focus of the metaphor is the nominative unit corrected by renaming. A change occurs in the meaning of the repeated nomination unit.

The second element observed during metaphorization is the metaphor frame. A metaphor frame is a context that creates a change in the initial meaning of a re-nominative unit. The context makes the new meaning explicit.

The third element of the metaphorization mechanism is the main subject. The main subject is the one that assumes certain properties and qualities. Named within a metaphor, usually not. The fourth element of the mechanism of metaphorization is called the secondary subject. This subject creates associative information about the named [1, p.169]. When the mechanism of metaphorization is approached in this way, the main feature of the metaphor is revealed as its duality. That is, the metaphor can refer to two subjects at the same time. The property of what is being talked about becomes clear through the prism of the property of what it is called.

Due to the fact that religious concepts belong to the field of spirituality and have a sacred character, difficulties arise in naming them, as well as in their interpretation and verbalization. It is known that the verbalization of spiritual experience as a complex conceptual field has various limitations, including linguistic ones. From this point of view, there is a lack of nominative units in the description and explanation of the concept of religion [4, p.173]. However, with reference to religious discourses and the interpretation of religious concepts in literary texts, it can be said that the limitation of the semantic possibilities of the words used to convey religious concepts can be overcome with the help of names and predicates [6, p. 126]. It should also be noted that historical experience creates a basis for balancing the asymmetry between form and content in discourse. Such adjustment is possible due to special linguocognitive operations. As a result of the actualization of the conceptual metaphor, it becomes possible to apply to the field of predicates non-object essences, observable and thus perceived properties.

Quite a few metaphorical predicates can characterize abstract religious concepts based on similarities with physical objects and events. This is explained by the theory of conceptual metaphor, which refers to the interaction process of two knowledge structures at the basis of metaphorization. The first of the two mentioned knowledge structures is called the source area, and the other is the target area [8, p. 78]. On the basis

of the metaphorical vision formed as a result of the interaction of the person with the environment, the elements of the source area are projected onto him, that is, to the target area, which is less clear to the person. Since the main source of the communication participant's knowledge about the world is his initial physical experience, the categorization of the perceived reality is carried out by means of simple images conditioned by this experience.

Religious metaphors are created on the basis of conceptual transfers. T.Y. Litvinenko studied this issue in his research called metaphor in religious discourse. He showed that metaphorization creates metaphors for a number of concepts with the light source field, and defined various metaphorical models. The wide application of religious metaphors in the creation of conceptual transfer of a unit belonging to the field of models such as religion is light, God is light, life is a way, religion is to see, religion is a living being, God is a helper, God is a provider has been interpreted on the basis of examples in this research work [8, p.512]. It should be noted that metaphors formed on the basis of these models are used more often in artistic discourse. At the same time, different metaphorical models are revealed in artistic discourses. In general, there are many such conceptual metaphor models and it is difficult to predetermine their possible forms.

"He'll take it," the old man said aloud. "God help him to take it."

He didn't take it though. He was gone and the old man felt nothing.

"He can't have gone," he said. "Christ knows he can't have gone. He's making a turn.- He doesn't want to eat anything, - shouted the old man, - God himself has provided for him... But it seems that the fish did not come to the fish, but passed by. The tilov rope was no longer moving. The old man did not understand anything. - He cannot go, Hazrat Isa himself will not let him go.

God help him – God helps him.

It is He (God) who created all that is on earth for you, then turned to the sky and arranged it in the form of seven layers of heaven! He knows everything. The world is roasted and burned by its brutal oppression. The human-wild substitution is a metaphor. That it is a religious metaphor is confirmed by the fact that man does not fulfill the purpose for which God created him and creates atrocities. When a person turns away from God, he serves the devil, stays with him, and remains alone with him.

In the example, the old fisherman turns his face to God and asks God for help. Therefore, he does not believe that the fish will give up the bait in the tilov. The fish's swallowing of the bait finds its expression with the help of God. A conceptual metaphor is created in the form of a descriptive metaphor.

Neither man nor animal can escape God's command (Christ knows he can't have gone. He's making a turn).

However, when they are alone with their devils (with their friends who deceive them), they say: - We are with you, we are only mocking (believers), - they say. Listening to the heart and conscience, which are

abstract concepts, is directly related to religion, it implies being religious, faithful and honest. It is believed that a person's conscience and heart do not deceive him. When a person listens to his conscience, he is on the right path. The opposite of this is to take a crooked path, a path that is not God's. A literary text does not create metaphor through ordinary substitution like metonymy. The process of formation of metaphor is different from the formation of metonymy. Here, substitution is often not directly noticeable. Religious metaphors are much more complex than ordinary life metaphors. A religious metaphor requires religious background knowledge, and the need to understand the mechanism of substitution.

Malak is an Arabic word, etymologically from Hebrew or Abyssinian, and its meaning corresponds to the verb to send in Azerbaijani. This word, i.e. angel, gives the meaning of messenger, and from here it also gives the meanings of messenger and messenger. In all heavenly religions, angels are beings who carry out the work of bringing messages between God and man. Angels are considered spiritual beings. They are invisible, free from ego, far from sensuality. From this point of view, angels are pure, pure beings created by God who always worship God and fulfill God's commands without question.

- (O Prophet!) Prostrate to us angels - Adam! - when he said, (everyone) prostrated except for Iblis.

During Jahiliyyah, angels were called daughters of God. In verse 57 of Surah An-Nahl (The Honey Bee) of the Holy Quran, it is said: - They ascribe girls to Allah. (angels are daughters of God, they say). God is pure and holy. (he does not need sons and daughters). As for themselves, they attribute what they want (male children). There is no information about the division of angels into sexes. Nevertheless, they are superior, pure, pure, sublime creations. In the Psalms revealed to Prophet David, the most superior beings created by God are called spirits and angels. From here it can be concluded that according to purity, beauty, creation from light and ancient mythologies, angels are metaphorically identified with beautiful girls. Metaphors of girl - angel, girl - goddess, woman - angel, woman - goddess are widespread in both classical and modern literature.

But the old man always thought of her as feminine and as something that gave or withheld great favors, and if she did wild or wicked things it was because she could not help them. - But for the old man, the sea was everything, the sea was his life; the old man looked at the sea as a goddess. What did this goddess not give her human son?! How generous and gracious He is!

In E. Hemingway's story "The Old Man and the Sea", the hero compares the sea to a goddess, an angel, and draws attention to its kindness. The metaphor of sea - woman, sea - goddess, angel is motivated by the fact that the sea provides sustenance to a person, it makes many things live in his heart. Here, the primacy of the woman-goddess, woman-angel metaphors also plays its role. It should also be noted that it is not identified with the image of a mermaid. Because there are myths and legends about fairies living in the sea.

S. Shikhiyeva writes: "The image of a fairy in Divan literature is neither a source of evil as in the Avesta, nor faithful lovers who yearn for communication with the human race and wait for them, as in most of our fairy tales. Fairy girls are almost completely transformed figures in divan literature, and with their appearance, they have become a symbol of beauty and purity, leaving them from being a source of fear, horror, and evil, from belonging to the tribe of demons" [5, p.335].

From a religious point of view, man's existence in this world is the existence created by God, and his life is the life that God has given him. Therefore, God is the creator of man, his author. Every person's life is a book written by God. In many languages, including modern English, the book of life metaphor is used. Human life - book, human life - story, human life - work, etc. reflected as metaphors. A person enters the stage at birth, plays his role in this world. V. Shakespeare, as well as the works of other English poets and writers, used the metaphor models mentioned above.

Life's but a walking shadow, a poor player
That struts and frets his hour upon the stage,
And then he heard no more. It is a fate
Told by an idiot, full of sound and fury,
Signifying nothing [Important Quotes Explained].

The human life - book, human life - text metaphor comes from the Bible. Reading this book or text to the end is possible for its creator - Allah. The Bible mentions the division of metaphors into two parts. The first part is considered as generic level, and the second part as specific level metaphors [2, p.375].

The metaphor used in Macbeth is a small level metaphor and is related to the life of an individual. In Macbeth's speech, the phrase Life is a tale is used, which means that life is a play, a human player/actor (player- Life's but a walking shadow, a poor player). A biblical metaphor refers to the book through which God guides man. Human life should be lived according to the rules and teachings given in the book sent by God. But in real life, people do not follow this path at all, they play their own games. Thus, in the given example, human-actor, life-play microlevel and life-book, life-text metaphors are registered.

There are many metaphorical images found in the Bible. These metaphors later appeared in English literature in one form or another.

In general, the metaphorization of religious-mythological beings is a widespread phenomenon in English fiction, especially in poetry. In addition, the religious space of heaven and hell is distinguished by its functionality as a metaphor.

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THE EVOLUTION OF TERMINOLOGY: ORIGINS AND ADVANCEMENTS IN WESTERN CONTEXTS

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Abstract

In the first half of the 20th century, the burgeoning wave of scientific and technological innovations underscored the imperative of efficient scientific communication. Within the rapidly expanding frontiers of scientific disciplines, the process of naming newly discovered concepts emerged as a cornerstone directly influencing language. While the creation and utilization of terminology has perennially held significance in the scientific realm, the 20th century ushered in a new era marked by the globalization of knowledge through the expansive reach of communication technologies.

In response to this transformative backdrop, institutions and specialized fields dedicated to the study of terminology emerged, effectively orchestrating terminological activities across multiple languages. This study conducts a comprehensive exploration into the contextual factors that precipitated the establishment of terminology as a distinct field of study, critically examining its contemporary state from a multifaceted perspective.

Through a meticulous survey of historical trajectories and a discerning analysis of the impact of technology on global scientific communication, this article presents a comprehensive understanding of the formation and the current status of terminology studies. It underscores the pivotal role of terminology in facilitating precision and clarity in specialized discourse and ultimately fostering efficient communication in the dynamic landscape of 20th-century science.

Keywords: term, terminology, lexicology, linguistics, Terminology in the 20th century.

1. Introduction

Throughout the course of human history, the bifurcation of practical pursuits and subsequently scientific domains has resulted in the genesis of distinct lexicons exclusive to each field, accessible only to practitioners possessing specialized expertise. The inception and maturation of the discipline dedicated to the study of terms, namely terminology, however, do not trace their roots to antiquity.

Terminology assumed the status of an autonomous scientific discipline in the 1870s, primarily finding resonance within the purview of translation studies during the subsequent decades. The post-World War II era marked a pivotal juncture, witnessing the elevation of translation to a global echelon. This epoch coincided with a notable upswing in international interactions and agreements, synergistically fostering an environment conducive to the evolution of terminology. Entities such as the United Nations, European Union, and similar international cooperation institutions established translation centers, thereby expediting the momentum of terminological development. The crucible of substantial terminological endeavors during this period lay notably in France and Canada [6, p.233-239].

A diachronic scrutiny of terminology's developmental trajectory reveals a methodical delineation into several discernible stages. The annals of terminological evolution bear witness to epochal shifts and technological leaps, paralleled by analogous societal and industrial advancements, collectively impelling progress in the domain [2, p.59-76].

Particularly, the burgeoned activities in the sphere of data processing have engendered novel conceptuali-

zations within the purview of terminology. The expeditious proliferation of written communication in the virtual realm precipitated the application of information processing modalities, notably manifested in electronic dictionaries, across multifarious realms of human activity [2, p.59-76].

2. Unveiling the Origins of Terminology Research in the Western World

The inaugural contribution to the discourse on terminology within the Western intellectual tradition is credited to Plato, whose inaugural treatment of terminological matters occurred in his work, "Cratylus." Extending from antiquity through the 16th century, adherents of Stoic philosophy, Augustine Averley, Anslem Canterbury, as well as scholars from Indian and Arab traditions, perpetually engaged in scholarly pursuits concerning terminology. The conceptualization of a nascent scientific domain delineating the processes of nomenclature and the requisite methodologies materialized subsequent to the Renaissance [3, p.11].

A methodical exploration commences with France, a pivotal locus in the evolutionary trajectory of terminology. Researchers within this domain accentuate the pivotal role of dictionaries for pedagogical and instructional objectives. Thus, during the 17th and 18th centuries in France, an enlightened individual was cultivated through the judicious inclusion of scientific and technical terms within dictionaries [2, p.60].

The 17th century heralded a transformative epoch marked by rapid advancements in scientific domains, instigating the broadening of the purview of the scientific discipline dedicated to the examination of terms. Notably, within the realm of botanical science during this epoch, Andrea Kesalpini formulated a comprehensive normative framework for categorizing observed

flora, deeming it imperative to categorize them into distinct classes [4, p.13].

Subsequent to Kesalpini, Antoni Furetier, in his 1690 opus titled "Dictionnaire Universel," not only recognized but delved into the critical import of defining and organizing scientific terms. Furetier's scholarly inquiries transcended the confines of lexicology, extending into the specialized domain of terminology [4, p.12].

During the 18th and 19th centuries, specialists accorded terminology the status of an incontrovertible science. Notably, two eminent figures of this epoch, Denis Diderot and Jean Leron D'alambert, collaborated on the seminal work titled "Encyclopedie." This oeuvre, presented in an alphabetical format, stands as a watershed in the domain of terminology, arguably constituting the earliest terminological dictionary. Beyond the mere recognition or comprehension of words, this work accentuates their meanings and conveys pertinent information [2, p.60]. Such endeavors serve as tangible evidence of the scholarly investigation into scientific terms during this period. Comparable contributions, including Samuel Johnson's English dictionary, played a pivotal role in catalyzing the crystallization of terminology as a distinct scientific field. Subsequently, the surge in innovations, inventions, and discoveries within the realms of science and technology underscored an imperative necessity for precise and standardized terminologies [4, p.12-13].

As alluded to earlier, the 18th and 19th centuries witnessed the preeminence of terminology predominantly within disciplines such as botany, philosophy, and chemistry. The fabric of this field was woven by scholars operating across diverse scientific domains who actively engaged in the compilation of encyclopedic works. Noteworthy transitions occurred in the 20th century as engineers joined the cadre of scientists. Their inclusion was deemed imperative for maintaining conceptual coherence in nomenclature, particularly with regard to the names assigned to scientific innovations in the burgeoning domains of science and technology.

3. Exploring Key Trajectories in 20th Century Terminology Studies

The genesis and contemporary vitality of modern terminology science have been significantly shaped by various intellectual currents, distinctly classified by theorists into four categories: linguistics, translation, planning, and creation. The linguistic paradigm, in particular, has played a pivotal role in the evolution of terminology, with three notable schools emerging as foundational forces: the Vienna School, the Prague School, and the Moscow School. These influential schools have been instrumental in delineating and consolidating terminology as an autonomous scientific discipline [2, p.64].

In the early 20th century, the burgeoning need for a scientific and technological foundation in Germany catalyzed a surge in research focused on the technical language employed by engineers. This interdisciplinary initiative attracted a cadre of specialists, including linguists, philosophers, and standardizers. Among them, the Austrian engineer Ögen Wüster, in his doctoral thesis titled "International Language Exchanges in the Field of Engineering, Especially Electrical Engineering," played a seminal role and is now widely acknowledged as the progenitor of modern terminology. His

work is currently esteemed as a seminal contribution to the field [1, p.35].

Upon entering this domain, Wüster initially encountered skepticism from certain academic quarters, dismissing his work due to his non-linguistic background. However, subsequent events revealed the unwarranted nature of these criticisms. Moreover, the trajectory of terminological activities globally shifted to incorporate not just linguists but also domain experts in the terminology creation process.

In 1935, at the behest of the Academy of Sciences of the USSR, Wüster's dissertation underwent translation into Russian, resulting in its publication. This event stirred considerable interest within the Russian scientific community, reshaping perceptions among Russian researchers and fostering close ties between Wüster, researchers, and terminologists within the USSR [1, p.47].

Wüster's seminal work, as articulated in the aforementioned book, constitutes a comprehensive examination of terminology's role as a medium for relationship formation. The treatise delves into nuanced issues such as the essence of concepts, inter-concept relationships, characteristics of concepts, definitions of concepts, term formation, standardization of concepts and terms, and the internationalization of concepts and terms [1, p.47].

In 1926, through the persistent endeavors of Wüster, the scientific committee ISA 37 (International Federation of National Standards Federation) was initiated, focusing on the development of terminology and principles governing terminological processes. Despite a hiatus during the Second World War, Wüster's concerted efforts led to the committee's reinstatement in subsequent years.

Wüster, a seminal figure associated with the Vienna School and credited with its establishment, initially concentrated on the scientific dimensions of term processing and standardization during the nascent phase of this field. However, by the 1970s, his intellectual successors introduced a set of principles known as the General Theory of Terminology, comprising five key tenets:

- 1) The initiation of terminology work commences with the conceptual framework, with the primary objective of demarcating clear and precise boundaries between concepts.

- 2) Each concept exists within a broader conceptual network, amenable to exploration through inherent properties, delineating distinct boundaries and frameworks for concepts.

- 3) The definition of each term serves the purpose of situating it within the overarching conceptual network.

- 4) A reciprocal relationship exists between each concept and its corresponding term, embodying the principles of singularity and singularity.

- 5) Within the science of terminology, heightened emphasis is placed on the dimensions of simultaneity [5, p.79].

The enumerated principles epitomize the onomasiological foundations of the Viennese school, signifying an approach that commences by establishing the concept before seeking its nomenclature. Presently, contemporary methodologies scrutinize terms as linguistic units, adopting a semantical perspective that

considers the expression of a concept after the enunciation of the term.

In the contemporary linguistic landscape, terminology is undergoing dynamic development on two distinct fronts: intra-lingually, whereby it evolves from within the inherent lexicon of a language, and inter-lingually, marked by the assimilation of terms from foreign linguistic sources. Notably, throughout the 20th and 21st centuries, terminology has emerged as a foundational catalyst for the facilitation of dependable and efficient communication within specialized domains.

The intrinsic evolution of terminology, primarily driven by the organic growth of language, reveals an intricate tapestry of lexical expansion and refinement. In this intra-lingual dimension, terminology delineates and refines the specialized lexicon of a language to meet the precise communicative needs of various domains, rendering linguistic constructs that are tailored to convey nuanced and complex ideas. In doing so, it navigates the intricate intersections of linguistic morphology, syntax, and semantics to craft terms that serve as efficacious tools for disciplinary discourse.

In parallel, the inter-lingual facet of terminology emerges as a significant modality, characterized by the assimilation of foreign terminology into the linguistic framework of a given language. This process is often necessitated by the inexorable march of globalization and the proliferation of international collaboration, as fields of knowledge and expertise transcend linguistic and geographical boundaries. Consequently, this dimension of terminology encapsulates the intricate dynamics of borrowing, adaptation, and integration of terms from diverse linguistic origins, accentuating the complex interplay between language contact, bilingualism, and sociolinguistic variables.

In the contemporary epoch, terminology's pivotal role in fostering reliable and efficient communication within specialized domains cannot be overstated. As society traverses an increasingly complex and interconnected landscape, terminology stands as a linchpin in ensuring precision and clarity in discourse. Its capacity to encapsulate nuanced meanings, maintain consistency, and accommodate the exigencies of diverse fields underscores its significance as a unifying force in the intricate tapestry of linguistic communication. Furthermore, the recognition of terminology as a conduit for cross-disciplinary dialogue underscores its evolving role as a critical factor in promoting the seamless exchange of ideas, knowledge dissemination, and the advancement of specialized fields.

4. Terminology

Terminology, etymologically rooted in the Latin "terminus," signifying "term," and the Greek "logos," denoting "concept" or "teaching," constitutes a specialized discipline focused on the study, management, and generation of terms. The emergence of terminology as a scientific domain is intrinsically linked to the exigencies arising during the developmental epoch of science and technology. The foundational tasks within terminology encompass the rectification of terms in adherence to grammatical conventions, the accommodation of borrowed terms within linguistic norms, and the innovation of novel terms through harnessing the inherent capacities of language [7, p.192].

The nomenclature "terminology" first surfaced in scholarly discourse during the initial half of the 18th century, credited to the German professor Christian

Gottfried Schütz, who introduced the term "terminologie." A notable instance of its application transpired in 1801 when Sebastian Mercier employed it somewhat controversially in a French publication [4, p.5].

An overarching inquiry into the nature of terminology scrutinizes its historical evolution, providing insights into its conceptualization as a scientific field. The term's formal adoption occurred in the latter half of the 18th century. Anchored in the comprehensive exploration of term origin, developmental trajectories, utilization patterns, and standardization procedures, terminology endeavors to furnish precision and clarity to the lexicon of various specialized domains [4, p.15].

The impetus for the genesis of terminology can be ascribed to the rapid advancements in science and technology during the 18th and 19th centuries. These transformative developments necessitated the cultivation of distinct scientific realms, each engendering its proprietary terminology. In response to this proliferation of linguistic innovations and cross-language transfers, the imperative arose to institute a scientific discipline—terminology—to regulate and manage this dynamic process effectively. At its core, terminology is concerned with the meticulous formulation of terms, or the assimilation of borrowed terms into a linguistic milieu, ensuring that concepts germane to a given scientific domain attain precision and comprehensibility.

When elucidating the concept of terminology, a comprehensive characterization within a generalized context can be proffered, framing it as a scientific discipline integral to the methodical investigation and regulation of terms. A more nuanced explication, as furnished by the International Terminology Association, posits terminology as a specialized field delving into the examination and application of symbols and linguistic signifiers requisite for nuanced communication within domains necessitating specialized knowledge. Crucially aligned with linguistics, specifically within the expansive purview of semantics and pragmatism, terminology emerges as an interdisciplinary domain. This characterization stems from its assimilation of concepts from diverse scientific realms, including semiotics, information theory, and classification, along with the application of methodologies rooted in these scientific arenas.

The purview of terminology extends to the scrutiny of the definition, organization, and utilization of words across varied scientific domains. While its historical trajectory primarily entailed the lexical examination of specific languages, contemporary terminology, from an applied standpoint, exhibits a close association with syntax and phonology. Moreover, its proximity to lexicology is pronounced, and it strategically incorporates methodologies from communication studies and technology in its applied dimensions [3].

The precise delineation provided by the International Terminology Association presents a lucid and comprehensible exposition of terminology, elucidating its operational domains and spheres. Functioning as a logical manifestation of the nomenclatural processes pertaining to diverse objects and concepts, terminology assumes a pivotal role within the matrix of social communication, interlingual relations, translation, and documentation. Its intricate interconnections with an array of domains, as underscored by its affiliations with se-

miotics, information theory, and classification, underscore the expansive and integrative approach inherent to the field of terminology [8, p.385-389].

Helmut Felber articulates a comprehensive tripartite delineation to explicate the multifaceted nature of terminology:

1) Interdisciplinary Nature: Terminology constitutes an interdisciplinary domain of scientific inquiry, engaging with conceptual frameworks and diverse modes of representing concepts, including terms and symbols.

2) Conceptual System Declaration: It serves as an assemblage of terms delineating a system of concepts germane to a specialized domain of scientific knowledge.

3) Systematic Conceptual Documentation: It encompasses works wherein the system of concepts inherent to a given subject domain finds expression through the utilization of terms [2, p.5].

An attentive examination of the elucidations offered by Felber culminates in the recognition that terms wield a distinctive linguistic function across all scientific and professional domains. Serving as a linchpin for communication amongst specialists, terms emerge as a pivotal factor fostering precision and efficiency in the communication fabric of scientific specialists. Emanating from these definitions, it becomes evident that terminology, operating as an interdisciplinary scientific field, straddles both applied and research-oriented dimensions. Inextricably linked to the broader science of linguistics by shared etymological roots, terminology establishes intricate affiliations with multiple branches within the linguistic realm.

Terminology, as an interdisciplinary science within the linguistic domain, scrutinizes the inherent logical nexus between conceptualization and the objects they represent. This encompasses an in-depth exploration of the intricate processes governing the ascription of names to concepts, the methodical systematization of specialized professional nomenclature, and their application across diverse fields. Consequently, the central tenet of terminology resides in the systematic organization of technical knowledge and concepts, establishing it as a pivotal responsibility within the terminological discipline.

Theoretically, the prospect exists to design a comprehensive conceptual framework encapsulating the entirety of a specific field. However, practical constraints dictate a focused examination of only a subset of a given domain. This pragmatic approach ensures the construction of a thoroughly systematic, controlled, and evaluable structure at the conceptual level. Consequently, the conceptual framework imparts constructive knowledge, albeit within a delimited domain, with a primary emphasis on augmenting information coverage within that specific area.

In light of the foregoing, it becomes apparent that a conceptual framework ought to integrate related subspecialties within a unified structure, establishing interrelations between them. This imperative stems from the need to forge cohesive ties amongst the diverse facets of a particular field, fostering a holistic and interconnected terminological landscape.

Terminology, as a multifaceted and interdisciplinary scientific pursuit, engages in a profound exploration of the intricate and logical linkages that underlie the conceptualization of notions and their real-world referents. It delves into the intricate process of assigning names to these notions, meticulously orchestrates the systematic categorization of specialized nomenclature intrinsic to various professional domains, and scrutinizes their versatile applications across an array of fields. Consequently, the science of terminology assumes a pivotal responsibility in the systematic structuring of technical knowledge and concepts.

In a theoretical realm, the tantalizing prospect arises of constructing an all-encompassing conceptual framework, one that encapsulates the entirety of a specific domain. Nevertheless, practical exigencies dictate a more focused inquiry, confining the study to a delimited portion of the field that permits the establishment of a rigorously systematic, controllable, and assessable conceptual structure. Consequently, the system of concepts imparts a form of constructive knowledge, albeit within a narrower ambit of the broader landscape. Its primary mission is to enhance informational coverage within a specialized context.

It is evident from the preceding discourse that the system of concepts must function as an integrative force, uniting various subspecialties within a coherent and shared framework. The overarching aim is to foster meaningful interrelations, thereby facilitating a holistic and nuanced understanding within the realm of terminological inquiry. In this unity of purpose, the science of terminology achieves a transformative role, propelling a comprehensive and interconnected terminological landscape, bearing testament to the criticality of its endeavors in facilitating precision and clarity in specialized discourse.

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**THE STORY "HEART OF DARKNESS" BY JOSEPH CONRAD AND THE FILM OF F. COPPOLA
"APOCALYPSE TODAY": INTERMEDIA STUDIO**

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**ПОВІСТЬ «СЕРЦЕ ПІТЬМИ» ДЖОЗЕФА КОНРАДА І КІНОФІЛЬМ Ф. КОППОЛІ
«АПОКАЛІПСИС СЬОГОДНІ»: ІНТЕРМЕДІАЛЬНА СТУДІЯ**

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Abstract

The article presents a study of the novel "Heart of Darkness" and the film "Apocalypse Today" by F. Coppola using the tools of inter-art comparative studies. The author offers a tested method of comparing the story with the film interpretation according to the following structural elements: real events, title, plot, narrative, chronotope, main characters, genre, in the form of a table and generalization scheme. The conducted intermedial study made it possible to identify commonalities in artistic works at different levels of content and form, revealed the peculiarities and effectiveness of the comparative method.

Анотація

У статті представлено дослідження роману «Серце півми» та кінофільму «Апокаліпсис сьогодні» Ф. Коппола з використанням інструментарію міжмистецької компаративістики. Автор пропонує апробовану методику зіставлення повісті з кіноінтерпретацією за такими структурними елементами: реальні події, назва, сюжет, наратив, хронотоп, головні персонажі, жанр, – у формі таблиці та узагальнювальної схеми. Проведена інтермедіальна студія дозволила виявити спільне у мистецьких творах на різних рівнях змісту і форми, розкрила особливості і можливості компаративного методу.

Keywords: Inter-art comparative studies, transformational intermediality, intermedial analysis, genre, plot, main characters, prototypes, narratives.

Ключові слова: Міжмистецька компаративістика, трансформаційна інтермедіальність, інтермедіальний аналіз, жанр, сюжет, головні персонажі, прототипи, наративи.

Джозеф Конрад та його творчість – оригінальне явище у світовій літературі. Людина, яка поєднувала у своїй особі кілька культур: польську, українську, французьку, англійську, – виявилася ще й обдарованою художнім талантом. Юзеф Теодор Конрад Коженівський став автором літературного тексту у віці 36 років, написавши англійською мовою свій перший роман «Олмейєрова примха». У цей час він перебував в Україні у маєтку свого дядька й опікуна Т. Бобровського на Вінниччині у м. Новофастів. Наступні твори прославили Джозефа Конрада (а саме такий псевдонім обрав собі Коженівський) як мариніста, тонкого психолога, знавця людської душі і забезпечили йому почесне місце у світовій культурі.

Повість (окремі дослідники називають твір романом) «Серце півми» також була створена на основі власних вражень Ю.-Т. К. Коженівського, на той час капітана далекого плавання, про подорож до Конго.

Про цей твір схвально відгукнувся англійський письменник Джон Голсуорсі, допоміг надрукувати текст, у якому з глибокою психологічною майстерністю описані характери, вчинки, долі людей, екзотика й особливості природи та звичаїв населення Малайського архіпелагу. Роман став початком письменницької стезі капітана далекого плавання.

За мотивами повісті «Серце півми» режисер Ф. Коппола створив кінострічку «Апокаліпсис сьогодні» (1976 р.), у 1993 р. було знято телефільм «Серце темряви». Сама книга фігурує та цитується у фільмі «Кінг Конг» 2005 року. Те, що перенесення на великий екран «Серця півми» планували відомі режисери Орсон Веллс та Річард Брукс, засвідчує високу мистецьку цінність цього твору й актуальність порушених проблем.

Мета цієї наукової розвідки – здійснити інтермедіальний аналіз повісті «Серце півми» та кіно-

фільму «Апокаліпсис сьогодні» Ф. Копполи, виконавши інструментарій міжмистецької компаративістики.

«Серце п'їтьми», як і вся творчість письменника, розглядається сучасними дослідниками у різних контекстах: історико-літературному, літературознавчому, мультикультурному (К. Каплан, К. Карабін, О. Ноулз, П. Армстронг, Т. Міддлтон, З. Найдер, Д. Петерс, Д. Стейп та ін.). Проблему колоніалізму, так своєрідно і глибоко окреслену у творі, досліджує Д. Мур у площині культури, історії, текстології, наратології, стилістики. Як роман-пересторогу, роман-передбачення розкриває Т. Литвиненко. Г. Блум, автор книги «Західний канон. Книги на тлі епох», назвав роман «Серце п'їтьми» «найстрашнішою метафорою Джозефа Конрада» [2], оскільки це було передбаченням дикторських режимів радянської епохи і всього, що вони принесли для усіх націй і народностей тодішнього радянського союзу.

Українські дослідники акцентували на різних аспектах твору: О. Рудюк та В. Білявська на жанрі, визначивши його як модифіковану «екзотичну повість», «яка функціонує на пограниччі пригодницької та психологічної прози» [11, с. 92.] Неоромантична манера письма, на думку авторів дослідження, виявилася в особливостях хронотопу, в його багатоплановості, у структурі багаторівневого семантично-змістового нашарування образів, М. Панасюк розкриває проблему екзистенційної кризи людини у творі [8], Р. Туровський окреслює «апокаліпсис за Джозефом Конрадом» через антропологічні передумови катастрофи Заходу [15], специфіку образотворення (образи-символи, зокрема, образ зла), особливості авторської нарації (О. Коляда) [6].

Окремі дослідження присвячені спробі зіставлення кінострічки Ф. Кополли «Апокаліпсис сьогодні», японського аніме-серіалу «Психопаспорт» («Psycho-Pass») та повісті «Серце п'їтьми» (Д. Капелюх, Ю. Смолкіна) [5; 12] Є статті, присвячені аналізу кінострічки [4, 10, 13]

Однак заявлена тема потребує глибшого аналізу й відповідного інструментарію для інтермедіальної студії.

Оскільки твір вивчається у закладах вищої освіти в контексті британської літератури модерного періоду, а в 2022 році його включено до програми із зарубіжної літератури для 9 класу [3], то таке «прочитання» твору й кіноінтерпретації сприятиме глибшому розумінню та сприйняттю мистецьких творів і формуванню літературознавчої й

компаративної компетентності здобувачів освіти різних рівнів.

Автор цієї статті пропонує апробовану методику контекстного вивчення твору та зіставлення повісті з кіноекранізацією, що дозволяє не тільки представити й проаналізувати твір модерного періоду, а й ознайомити з кінофільмом видатного американського режисера, розкрити особливості і можливості компаративного методу в контексті інтермедіальних студій.

Сучасне літературознавство оперує новим терміном «інтермедіальність», який увів О. Ханзен-Льове за аналогією до терміну «інтертекстуальність» (Ю. Крістева). Дефініція цього поняття розкриває взаємодію в межах однієї знакової системи. За О. Поповою, теорія інтермедіальності на сучасному етапі її формування – це модифікація теорії інтертекстуальності, адаптованої до міжмистецьких взаємозв'язків». [9, с. 163]

Інтермедіальність – це, з одного боку, використання художньою літературою інших видів мистецтва, задля посилення ефекту та поглиблення головної ідеї та змісту твору: музики, живопису, скульптури, кіно тощо, з іншого – це й методологія порівняльного аналізу художнього твору і культури загалом. [19, С. 163-164].

Існує кілька класифікацій інтермедіальності. Найпоширеніші з них поділяють інтермедіальність на основі засобу поєднання або переведення медій. Учені визначили три види інтермедійних поєднань: комбінація, інтеграція і трансформація. [16, с. 56]. Й. Шрьотер розмежовує чотири типи інтермедіальності: синтетичну, трансмедійну, трансформаційну й онтологічну [17, с. 55]. Трансмедійна, тобто формальна, інтермедіальність має у своїй основі естетичну реалізацію в одному медіумі формальних структур іншого медіума, трансформаційна – репрезентацію одного медіума в іншому, онтологічна – вияв якостей одного медіума через зіставлення з іншими, використовуючи певну міжмистецьку паралельність.

Скористаємося трансформаційною інтермедіальністю як методологією літературознавчого дослідження художнього тексту та його кіноінтерпретації. Для цього на основі аналітико-синтетичної роботи створено авторську таблицю, у якій відображено основні структурні елементи художнього та кінематографічного творів: жанр, сюжет, головні персонажі, прототиби, наративи, – та узагальнювальну схему.

Таблиця 1

Повість і кінофільм: зіставний аналіз		
«Серце півдня» п повість (роман)	Спільне	«Апокаліпсис сьогодні» кінофільм
Реальні (історичні) події		
Колонізація Африки (Конго) європейцями	Завоювання нових земель.	Війна американців у В'єтнамі.
Назва		
Південь – це те, що незвідане, приховане у джунглях Африки й у серці людини. Відображає головну думку автора: серце півдня знаходиться в душі людини, яка втратила відчуття реальності, перейшла межі людського і людяного.	«Жах! Жах!» «Душа заглянула у себе і збожеволіла». [7]	Відображає головну думку режисера: така цивілізаційна загарбницька місія білих людей є апокаліпсисом для нововідкритих земель, де люди жили за законами природи. З іншого боку, апокаліпсис відбувається в душах людей: зворотної, антигуманності, жорстокості.
Сюжет		
Капітан далекого плавання Чарльз Марлоу перебував в Лондоні після 6 років плавання по східних морях, втомився відпочивати і шукав можливість продовжити плавання, втілити мрію дитинства – відкрити для себе білу пляму на географічній мапі – Конго. Марлоу, уклавши угоду з торговою компанією як капітан торгового судна, відправляється в Конго. По дорозі він дізнається про Курца, найуспішнішого агента компанії із видобутку слонової кістки, який завдяки особистісним непересічним якостям, а також жорстокості, зумів підкорити собі тубільців, які почали поклонятися Курцу як напівбогові. Чарльз Марлоу знайшов Курца, на той час хворого, переконав залишити джунглі. По дорозі Курц помер зі словами на устах «Жах! Жах!», а Марлоу все зробив від нього залежне, щоб у пам'яті нареченої, яка кохала Курца, і сприймала як видатну, виняткову особистість, він залишився людиною.	Даремне марнування часу на суші головних персонажів. Очікування роботи (завдання). Отримання бажаного (роботи, завдання). Подорож. Пригоди, випробування, Зустріч з Курцом. Смерть Курца і його останні слова «Жах!» «Жах!» «Засуджувати за вбивство тут, на цій війні, так само безглуздо, як штрафувати за перевищення швидкості на перегонах Формули-1», - Віллард. [1]	Капітан повітряно-десантних військ американської армії Бенджамін Віллард після виконаного на війні завдання нудився у Сайгоні, зловживав алкоголем, чекав наступних розпоряджень. До нього завітали двоє офіцерів, привели його до тям, доправили в центр контррозвідувальних операцій. Там вручили секретний наказ, за приписом якого він мав вирушити у джунглі Камбоджі, знайти полковника Курца, який вийшов з-під контролю, самовільно залишив свій армійський підрозділ і втік у джунглі, де «очолив армію бойовиків, які моляться на нього, як на Бога». Його звинувачують у вбивстві офіцерів союзницької південнов'єтнамської армії, у жорстокості. Капітан вирушає угору по річці Меконг на патрульному катері виконати наказ. Упродовж небезпечної мандрівки став свідком жахливих і жорстоких боїв американської армії з місцевими військовими формуваннями, вбивств мирних мешканців. По дорозі він вивчає справу Курца, роздумує над його долею, дивується талантам. Коли зустріч відбулася, Курц утримував капітана як в'язня, наказав катувати, потім звільнив, розкрив свою філософію життя. Згодом під час ритуалу, коли тубільці вбивали бика, приносячи жертву, капітан вбиває Курца мачете. Той не чинить ніякого опору і вимовляє лише одне слово «Жах!» Цим він підсумував своє життя.
Наратив		
Наратив у наративі. Початок розповіді від імені автора, а потім оповідачем є капітан далекого плавання Чарльз Марлоу, директор акціонерної компанії і власник яхти «Неллі». Під час виму-	Нашарування наративів. Поєднання зовнішнього та внутрішнього (психологічного) наративів.	Паралельні наративи: зовнішній – події, які відображені на кадрах, і внутрішній – голос за кадром, який розкриває думки, враження, почуття капітана Вілларда про Курца на основі сповіді (зафіксованих спогадів, листів до дружини,

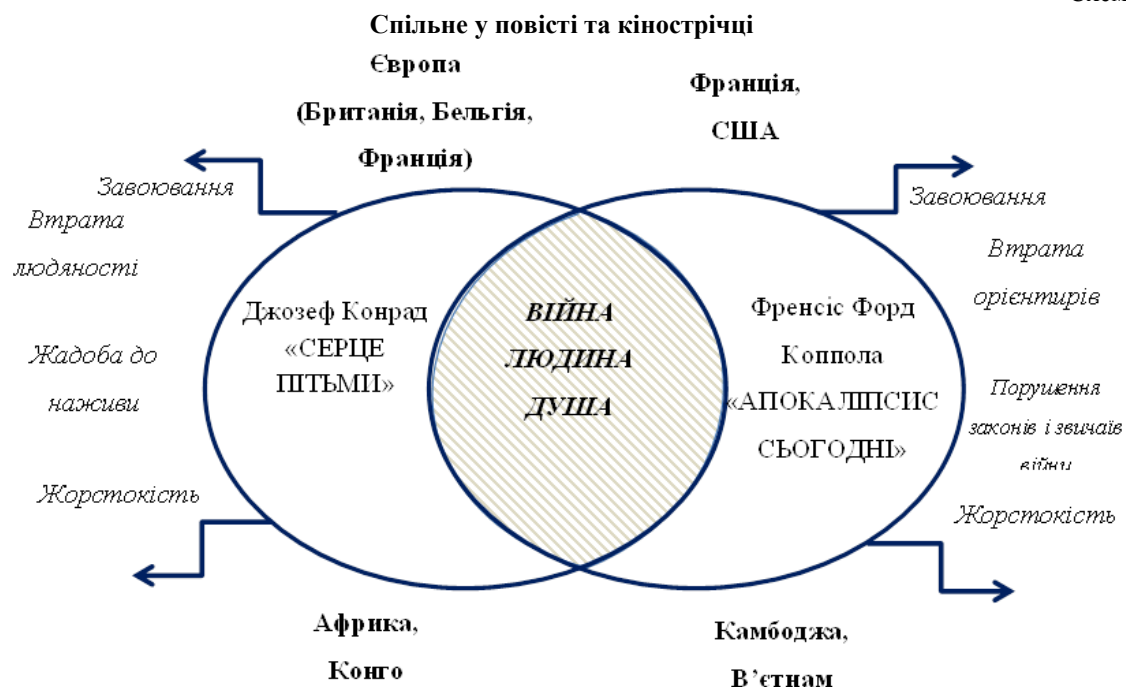
шеної стоянки (штиль), поставивши на якір яхту, де перебував разом із друзями, – колишніми моряками, розповідає їм про свою подорож до Конго і про свої думки, почуття, враження.		сина), про ставлення до нього. Свої роздуми Віллард так само називає сповіддю. Йому важко в чому сповідатися («Я хотів отримати завдання. Мені його дали за мої гріхи. Це завдання змусило мене зробити вибір»). [1]
Хронолог		
Ріка Темза, вічне місто Лондон, ріка Конго, місцевість Конго, джунглі. Кінець XIX ст.	Ріка, яка вигинається змією, для обох персонажів стала символом моральних і фізичних випробувань. Джунглі – це образ дикої природи, яка не приймає білих людей, виштовхує як чужих і ворожих.	Сайгон (В'єтнам), ріка Меконг, Камбоджа, джунглі. Друга половина XX ст.. (1969 р.)
Персонажі (головні герої)		
Капітан далекого плавання Чарлі Марлоу, справжній моряк, аскетичний зовні, схожий на Будду, вигадник, активний спостерігач, співчутливий до тубільців, сам прагне побачити і зрозуміти Курца, привести його до тями. Волт Курц, Визначна особистість, наділена багатьма талантами (про це розповідають Марлоу люди, які знали Курца). Він інтелектуал, філософ, має музичні здібності, талановитий оратор (мав незвичайний голос), декламатор поезії, має таку силу духу і таку харизму, що підкорює собі людей. «Він займав високе місце серед демонів тієї землі» (Марлоу). «Уся Європа брала участь у створенні Курца». Моряк (Арлекін), росіянин, син протоієрея Тамбовської губернії, (напівбожевільний), який сприйняв філософію Курца, захоплювався ним, його численними талантами, розумом, виправдовував його, проте визнавав жорстокість.	Головні герої – капітани. Обоє не знаходять себе поза основним заняттям. Вивчають життя, вчинки, характер, Курца ще до зустрічі з ним. Курц як «зав'язка». Неординарна особистість. Приголомшлива кар'єра завдяки винятковим здібностям. Курц переступив межу між добром і злом, створив свою філософію життя на війні, за якою себе оправдовував, став напівбожком для тубільців. Його голос мав великий вплив на людей. «Скиньте бомбу! Знищте їх усіх!» кінцева фраза Курца із його документа. Персонаж (Арлекін, фотокореспондент) своєрідний адвокат Курца, зачарований його харизмою.	Капітан повітряно-десантних військ Бенджамін Віллард (актор Мартін Шин), вишколений, загартований, учасник воєнних дій, витриманий, небагатослівний спостерігач, співчутливий до тубільців, має завдання вбити Курца. Полковник Волтер І. Курц (актор Марлон Брандо), один з найвидатніших військових в армії США. Зробив блискучу кар'єру, бездоганно виконував завдання, отримав близько тисячі подяк. Мав гострий розум, почуття гумору, був доброю і гуманною людиною, проте у боротьбі між раціональним та ірраціональним, між добром і злом у його душі перемогло зло, він переступив межу і втратив орієнтири. За певних обставин у нього виникла спокуса стати Богом. «Цілком очевидно, що він збожеволів» (з характеристики керівництва розвідуправління). Себе Курц порівнює з равликом, що повзе по лезу бритви. Зі спостережень капітана Вілларда: «Голос на півці зачепив за живе». «Він порвав із собою». [1] Фотожурналіст-американець, (напівбожевільний), (актор Денніс Гоппер) сприйняв філософію Курца, захоплювався ним, виправдовував його, визнавав жорстокість: «Світлий розум, але розлючена душа». «Як він читає поезію!» [1]
Прототипи		
«Бельгійський колоніальний офіцер Леон Ром (1859-1924), який працював в адміністрації Вільної	Реальні особи. Вчинки, характерні риси.	«Полковник Роберт Ро, якого у 1969 році віддали під суд за вбивство в'єт-

держави Конго. Ром був начальником станції в районі водоспадів Бойома і прославився своєю жорстокістю стосовно тубільців. За свідченням місіонерів, Ром "прикрашав" клумби навколо свого будинку відрізаними головами конголезців і на території його станції для остраху місцевих постійно стояли шибениці». [4]		намського подвійного агента. Як і вигаданий Курц, Ро навчався в "Вест-Пойнті" та брав участь у Корейській війні, де його нагородили "Срібною зіркою" за мужність і відвагу. У 1964 році Ро відправився до В'єтнаму, де став командиром групи "Зелених беретів" – елітного підрозділу армії США для проведення спецоперацій і ведення партизанської війни. Під командуванням Ро були не тільки американські військові, а й ціла мережа в'єтнамських інформаторів і агентів». [4]
Жанр		
Мариністична психологічна пригодницька повість.	Психологізм	Драма, психологічна драма, воєнний фільм.

У таблиці вміщено інформацію та цитати з повісті та фільму відповідно до названих розділів. Визначено, що спільне у творах різних мистецтв. Оскільки книга є першоосновою, то фільм – це інтерпретація команди, яка його створила: насамперед режисера, а також оператора, акторів, декоратора, композитора. Кіномистецтво за своєю природою синтетичне, поєднує слухові та зорові засоби творення, воно є просторово-часовим. Для передачі описів (природи, почуттів, портретів) у фільмі застосовуються різні прийоми: зйомки крупним планом, жести, міміка, рухи акторів, голос за кадром, музика. Музичне оформлення вражає: у кінострічці на початку лунає композиція «The End»

групи The Doors, коли ще немає ні назви, ні титрів. Чути приглушений гул гелікоптера, який наростає, далі відбувається бомбардування лісу, вибухи. Потім на цьому тлі поступово з'являється обличчя людини – головного героя, від імені якого звучить голос за кадром. Заголовну тему бою з опери Р. Вагнера «Політ Валькірії» використано в епізоді, коли гелікоптерний підрозділ підполковника Білла Кілгора починає атаку на пляж і село поряд із ним. Музика тріумфальна, оскільки Валькірії – діви, які покровительствують справжнім мужнім воїнам на полі бою, а у цій безглуздії і жорстокій розправі «Політ Валькірії» виконує роль своєрідного дисонатора. Зіставний аналіз узагальнено на Схемі 1.

Схема 1.



Таким чином, за допомогою інструментарію порівняльного аналізу художнього твору і кінофільму проведено інтермедіальну студію та виявлено спільне у наративах, персонажах, сюжеті, хронотопі, ідеї, жанрі. Висновок, який впливає із зазна-

ченого вище: Ф. Коппола взяв за основу текст Джозефа Конрада, проте використав сучасні події (війна американців у В'єтнамі), відповідно змінив хронотоп (події відбуваються у Сайгоні, на той час столиці Південного В'єтнаму та джунглях Камбоджі

у 60-ир роках минулого століття). Головним персонажем у кінострічці надана така ж роль і статус, як і в повісті: капітан Віллард, як і Марлоу, відкриває для себе Курца упродовж подорожі через свідчення інших людей, документи, намагається досягнути його особистості: вчинки, характер, світогляд, мотиви, спосіб життя, оцінює зі свого боку і настановується на трагедію непересічної особистості, яка вступила у конфлікт сама з собою у обставинах, спричинених війною.

І нарешті, головна ідея фільму збігається в обох авторів у запереченні війни як антигуманного засобу вирішення політичних суперечок, у засудженні завоюницької політики сильних держав, показі внутрішнього конфлікту людини, яка зробила вибір на користь зла у моральному виборі між добром і злом, раціональним та ірраціональним, і спокусилася статусом Бога, у випробуванні душі людини в умовах війни, що «заглянула в себе і збожеволіла».

Цим дослідженням не вичерпується тема інтермедіальних студій творчості Джозефа Конрада. Перспективним і цікавим може бути зіставне дослідження повісті «Лорд Джим» та її екранізації британським режисером Річардом Бруксом у 1965 р.

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PHYSICAL SCIENCES

TECHNOLOGY IS TRANSFORMING THE EDUCATION SYSTEM IN MODERN ERA

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Abstract

Technology is always intended to save time, boost efficiency, and make it easier to do certain physical or mechanical tasks. Almost all educational concerns, including school activities, have been mechanized by technology. True, why should a youngster or student learn the fundamentals of math when they can utilize a calculator on their phone? Or why should a youngster or student learn spelling, grammar, or writing style when autocorrection software is available? As a result of what began as a good purpose, future generations will be unable to accomplish basic cognitive tasks without the aid of technology. It is also true that when children or students rely on technology to handle every difficulty in education or at school/institute, they progressively lose their problem-solving talents, which are in high demand. Although digital or smart technologies have been shown to improve student advancement and project collaboration, many people ignore their biological need for real-time interaction, which is the only solution to such a peculiar problem. We have known for thousands of years that we have lived as social beings, and we now believe that we can simply fool our genetic propensity. Today, the quantity of explicit information available on the internet or online is astounding, and there are no age limitations, so children/students may easily access it. Furthermore, web access interferes with children's/students' physical activity, sleep, sociability, teacher-student connection, and so on. This is a research article that examines how technology is transforming the education system in this modern era along with benefits and drawbacks of technology in education in 21st century.

Keywords: EdTech, AI, IoT, robots, MOOC, LMS, Minecraft

Introduction

Learners of the 21st century differ significantly from those who existed prior to the advent of the Internet, online study, and digital learning. A more dynamic learning environment is produced by technology. As technology advances, classrooms are undergoing diverse redesigns and reinventions to cater to the growing demands of contemporary digital learners. Internet usage has developed into an indispensable information resource. The internet is replete with numerous student and children's publications that can aid a child in acquiring more information. It assists them in developing self-reliance as learners and gaining self-assurance. An additional benefit of the internet is that it provides children with an abundance of information that may inspire them to begin reading. The unbridled expression of children's imaginations is unforeseeable. These days, children have access to laptops, tablets, and a plethora of other technological devices that aid them in materializing their ideas. Although students still have access to traditional writing instruments such as pens and paper, they now have the ability to generate 3D animations rather than static images. They endeavor to create more intellectually and to experiment with novel concepts. It enhances their capacity for learning, thereby better preparing them for future endeavors. On the contrary, it is the most disconcerting consequence of unsupervised technology usage among children and students. Surprisingly much explicit information is accessible via the internet or online. Consequently, infants

and students who have unsupervised access to technology will have significantly simpler access. The majority of websites that exhibit such content lack age restrictions, making them accessible to students and children without difficulty. In addition, naive juveniles can be easily duped by malicious online users into divulging sensitive financial and security data or inappropriate images; this is especially true if guardians have not adequately educated their children about fundamental online safety. Additionally, online access hinders the socialization, physical activity, sleep, and teacher-student interaction of children and students. This is an analysis of the impact of technology on education, including a comprehensive evaluation of the advantages and disadvantages for students or children.

Technological advancements are enabling substantial changes in educational content, delivery, and accessibility. New technologies have aided the exponential rise of human knowledge throughout history. The early twentieth century was focused on the use of radios in education.¹ But since then, people who come up with new ideas have seen technology as a way to make conversation, learning, and mastering school-work better. Big changes are being made possible by the next wave of education tools. Games, simulations, and virtual reality are some of the new tools that are being used in education.² Presently, an increasing number of software applications are establishing environments in which pupils can guide the development of

¹ Reid, Seerley, and Daniel Day. "Radio and records in education." *Review of Educational Research* 12.3 (1942): 305-322, accessed on 13 Sep 2023

² West, Darrell M. *Digital Schools: How Technology Can Transform Education*. Brookings Institution Press, 2012

their own knowledge with minimal guidance from instructors. A potential benefit of digital technology is the potential for expense reductions. Over one million positions were lost in the education service sector throughout the Great Recession.³ The reduction in education expenditures by state and municipal governments has consequential ramifications across the education system. In the present day, educators across various educational institutions ranging from colleges to elementary schools have a heightened challenge due to a scarcity of resources. Considering the prevailing political landscape characterized by austerity measures, the prospects of a prompt reinstatement of financing to pre-recessionary levels appear to be minimal. In the present scenario, the significance of educational technologies is heightened as they strive to support overwhelmed educators in implementing the forthcoming wave of assistive technology. Education encounters distinct resource challenges that extend beyond just budgetary constraints. The duration of the school day is limited, and the allocation of teaching time is highly valued. Students from developed nations such as the United States allocate a comparatively lesser amount of time within the confines of a classroom, in contrast to their counterparts in several other countries throughout the globe. Despite the fact that teenagers engage in interactions with their parents, instructors, and friends, there has been a notable increase in the prevalence of diagnosed depression among young individuals. Presently, this figure has escalated to almost 20%, which is a significant development. The sole recourse available to instructors and educational institutions is to promote and foster interpersonal engagement among students or young individuals. The potential oversight of the expenses associated with technology upgrades or maintenance is a common occurrence. In an era characterized by frequent advancements in digital technologies and the escalating demand for more robust equipment to accommodate software and application upgrades, placing exclusive reliance on the notion that technology is the sole remedy for educational challenges appears too certain. The discussion centers around the notion that teaching and learning may be conducted in the absence of technology. However, the key inquiry pertains to the long-term use of the learned specialized skills in a context characterized by technological regression over subsequent generations.⁴ Therefore, educational institutions are obligated to estimate the actual long-term costs of that investment and how it will affect the tuition fees that students and their parents are required to pay in order to prevent regret regarding the purchase of new technology.

The acquisition of technical education and skills is of paramount importance in the development of human resources for any given nation. Education of this kind yields a proficient labor force, augments production, and contributes to the ame-

lioration of the overall quality of life for the populace. It is imperative to generate purposeful, qualified, and competent human resources in the contemporary period characterized by advancements in science and technology. Indeed, a strong correlation exists between the technical or vocational education system and the socio-economic growth of a nation. There is a lack of access to technical and vocational education among the younger generation and students from low-income, least developed, and developing nations. The observed metric exhibits a significant disparity and concerning trend when juxtaposed with other advanced and robust economies. There is a need to alter the mindset of parents and students in these nations, with an emphasis on prioritizing technical education above general education. This is the reason why a significant number of individuals with a general level of education experience unemployment on a global scale. Unemployed individuals provide a significant economic and social challenge for the nation and society. Unemployed teens often experience discontentment and may become involved in criminal activities and substance misuse. The global need for a proficient workforce is projected to experience a significant surge, including Middle Eastern nations. Presently, a substantial proportion of the labor force in these countries comprises individuals from impoverished, least developed, and emerging nations, who possess limited or moderate skill sets. This study employs an analytical approach, utilizing both primary and secondary sources, to evaluate how technology is transforming the education system in this modern era along with benefits and limitations of technology in education. Additionally, this study has included a diagnostic analysis to illustrate the essential requirements of technical education for the current generation.

Education Technology (EdTech) Tools and Its Impact

Using technology in the classroom doesn't have to mean using computers. There are many other ways to do it. As schools try to give their kids the best education possible, using technology in the classroom is becoming more appealing. The world of technology has changed a lot in the past few years. As more and more people get into digital media, it is important for teachers to use the newest tools in their work to keep students interested. For students to be interested in learning, it needs to be new and creative. Students should be excited about what they are learning. Because it is so important in today's education business, teachers have to know how to use educational technology.⁵ Technological advancements have had an influence on every aspect of life throughout the years. Technology has permeated every aspect of our lives as it has become more accessible, and as a result, we now demand all products

³ Haver Analytics. "Employment Household Survey" Employment: Education Services January 1983 to January 2013, accessed on 13 Sep 2023

⁴ <https://www.allisonacademy.com/students/self-improvement/importance-of-soft-skills-for-students/>, accessed on 29 Jul 2023

⁵ <https://elearningindustry.com/how-important-is-technology-in-todays-education-industry>, accessed on 24 Jul 2023

or tools that we use to be as technologically sophisticated as possible. Schools have also embraced technology as an essential component of their educational process, and as a result, they now offer computer science programs in which students learn how to code computers and utilize them for their work or projects. The usage of educational technology has therefore become vital for today's learners and students since it allows them to study at a much faster rate than they would if such tools and programs were not used.⁶ Schools or teachers which have adopted or replaced traditional classroom tools with equivalent technology tools known as EdTech tools and that has been given below.

a. Whiteboard Tools. The whiteboard was very common since long and which is going to replace by equivalent technology tool. Now, several whiteboard equivalent technology tools are providing the same experience like whiteboard.

➤ **Sketchlot.** This is free and works on most browsers and devices nowadays. It is intended for use by teachers and students. Using the tool requires teachers to create an account and then add a list of students. The teacher then assigns passwords to students. The passwords are used by students to join drawings shared by the teacher.⁷ The teacher can choose who they share whiteboard content. Students can also create drawings and share with their teachers.

➤ **Aww.** It is another app that is also browser based. A US\$ 10 monthly subscription is required to use the app. To use the app, go to awwapp.com and start drawing. One can invite people to see their whiteboard content by sending them the link of their drawing.⁸

➤ **Stoodle.** This is a free whiteboard tool. The tool is easy to start using. It is a free tool where users can join an online classroom by simply sharing an URL. It offers real time collaboration and communication; multiple users can work on the same virtual whiteboard at the same time through text chat and voice conferencing using their computer's microphone. They also can type, draw, and search and upload images.⁹

➤ **Draw It Live.** It is very much similar to Stoodle. Using Draw, It Live requires going to the website, click 'collaborative whiteboard' and giving it, a name and you are ready to go. Sharing the drawing is achieved by just inviting people by sending them the link given to your drawing. Draw It Live offers a free space for students to instantly create a collaborative whiteboard to use with anyone they like. Student can invite people to draw with them by sending them the URL assigned to their whiteboard.¹⁰

➤ **FlockDraw.** It was an online community where users could start drawing on a whiteboard and

invite others to collaborate. A group could have unlimited number of users who could draw in real-time. It also provided a live chat option.¹¹ Using FlockDraw requires visiting the website, click 'start drawing' button and you are ready to go. Sharing the drawing is by sending people the link of your drawing.

b. Presentation Tools. Several tools exist online that can be used for presentation. There are several online presentation tools are available now. Such as:

➤ **Prezi.** It is one of the best presentation programs available online. It is known for creating zooming presentations. To use Prezi, one requires signing up. A user is availed with many templates that they can use to create presentations. It gives the option of sharing the presentation URL or downloading then sharing. It allows for the addition of text, images, shapes, and other media.¹²

➤ **Glogster Edu.** It is a cloud-based (SaaS) platform for creating presentations and interactive learning. A platform that allows users, mostly students and educators to combine text, images, video, and audio to create an interactive, Web-based poster called glogs on a virtual canvas. Glogster facilitates the conveyance of social information in many different fields such as art, music, photography.¹³ Users also have access to a library of engaging educational content posters created by other students and educators worldwide. Glogster enables interactive, collaborative education and digital literacy. It allows for the addition of text, images, shapes, and other media. When done creating a presentation, just save and share with other students.¹⁴

➤ **Animoto.** It is intended for presentations that seek to deliver animated experience. The presentations generated by this online presentation tool are video based. It involves picking a style and a song that will be used for creating a presentation. You can then add photos, videos, and text. The final step is producing and sharing the presentation. It offers many templates for selection.¹⁵

➤ **Kizoa.** It provides the ability to create animated presentations, slideshows, or video. It is a blend of several online presentation tools features. To create a presentation using Kizoa, create a slideshow, and then select pictures. It offers the ability to edit the images so that they can blend into the background. Next, one selects transitions, animations or music for the presentation. Finally, edit the text, save and share.¹⁶

➤ **Photo Peach.** It is for teachers to create media rich presentation. It has a range of options for inserting

⁶ https://mashable.com/archive/technology-in-education/#Zl_DkQEpyqq0, accessed on 13 Sep 2023

⁷ <https://edshelf.com/tool/sketchlot/>, accessed on 09 Sep 2023

⁸ <https://www.oxfordlearnersdictionaries.com/definition/english/aww>, accessed on 09 Sep 2023

⁹ <https://blogs.umass.edu/onlinetools/community-centered-tools/stoodle/>, accessed on 09 Sep 2023

¹⁰ <https://freetech4teach.teachermade.com/2011/09/draw-it-live-simple-free-collaborative/>, accessed on 09 Sep 2023

¹¹ https://tracxn.com/d/companies/flockdraw/_cost-7Zi4WLgFLxxsbqMytz76393gJjjHhx96yW2TC8, accessed on 09 Sep 2023

¹² <https://prezi.com/>, accessed on 09 Sep 2023

¹³ Awada Ghada M et al, (2015-10-05), "Effect of Using the Glogster Technological Model on Enhancing the Perceptions and Speaking Proficiency of Communication Skills Students". *International Journal of Global Education*. 4 (2). ISSN 2146-9296

¹⁴ Sharon Martinez Alba et al, (2014), "Glogsters and Other Motivating Technology: A Multiple Case Study of English Learners", *Reading Matrix: An International Online Journal*, 14 (2), ISSN 1533-242X

¹⁵ <https://animoto.com/>, accessed on 09 Sep 2023

¹⁶ <https://www.kizoa.com/>, accessed on 09 Sep 2023

media, which make the presentation unique and creative. Allows or addition of background music or audio to suit a presentation.¹⁷

➤ **Channel Me.** This web tool allows a group of users to view the same content at the same time and chat with each other.¹⁸

➤ **Search Team.** It allows for small sized team to search together to achieve the best results.¹⁹

➤ **Mind42.** It is a web-based application that enables a group of users to mind map their ideas. It keeps track of the ideas.²⁰

➤ **Entri.** It is a free group tool for writing and sharing documents. It is intending for sharing documents with a group of users to get the feedback before releasing the final document.²¹

c. Course Assessment Tools. Uses of technology in education are increasing with advancement in technology. Many people are now using the online education platforms to get educated. Some of the

course assessment tools used frequently in online learning have been given below.

➤ **ClassMaker.** This online assessment tool is secure and web-based. It is easy to use and customize. It is intended for assessing tests and quizzes and provides instant grading.²²

➤ **ClassTools.** Used to create quizzes, games, activities and diagrams. It is a free tool.²³

➤ **Easy Test Maker.** A free online tool used to create tests. It has options for creating multiple choice tests, matching, and short answer questions.²⁴

➤ **Hot Potatoes.** It allows for creation of interactive quizzes as crossword, gap-fill, ordering, and multiple choices.²⁵

➤ **Quiz Revolution.** It used to create interactive quizzes for Facebook and online quizzes for embedding on websites.²⁶



Figure 1: EdTech and modern classroom Tablets and Chromebooks is educational tools

d. Library Tools. Adoption of eLearning is forcing education institutions to offer library services online. Besides, there are free online libraries providing e-library services. Examples of such online tools are as follows.

➤ **Free Book Spot.** This online free eBook source with over 4400 free downloadable eBooks.²⁷

➤ **4eBooks.** It has a huge collection of computer programming eBooks each downloadable.²⁸

➤ **Free-eBooks.** It is an online source that allows users to download free eBooks.²⁹

➤ **Many Books.** It provides free downloadable eBooks for iPod and eBook reader.³⁰

➤ **Get Free E-Books.** It is an online free eBooks source with over 4400 free downloadable eBooks.³¹

Massive Open Online Course (MOOC)

The term 'Massive Open Online Course' was initially introduced in 2008 by George Siemens and Stephen Downes. They facilitated what was arguably the first MOOC in that year. They provided a complimentary course titled "Connectivism and Connective Knowledge" in collaboration with the University of Manitoba's Extended Education and Learning Technologies Centre. The course was attended by more than 2,300 individuals and utilized an RSS aggregator to facilitate discussions.³² The word MOOC has evolved to refer to two distinct online venues. The approach to teaching that connectivist MOOCs take sets them apart. The MOOCs described in this article are defined by their association with institutions, financial supporters, and income generation possibilities. MOOCs have the

¹⁷ <https://www.pixtastock.com/c19/c6/c5/photo>, accessed on 09 Sep 2023

¹⁸ <https://channel.me/>, accessed on 14 Sep 2023

¹⁹ <https://searchteam.eu/>, accessed on 14 Sep 2023

²⁰ <https://mind42.com/>, accessed on 14 Sep 2023

²¹ <https://entri.app/>, accessed on 14 Sep 2023

²² <https://www.classmarker.com/>, accessed on 14 Sep 2023

²³ <https://www.facebook.com/ClassTools/>, accessed on 14 Sep 2023

²⁴ <https://www.easytestmaker.com/>, accessed on 14 Sep 2023

²⁵ <https://hotpot.uvic.ca/>, accessed on 14 Sep 2023

²⁶ <https://study.com/learn/revolutions-quizzes.html>, accessed on 14 Sep 2023,

²⁷ <https://freebookspot.club/>, accessed on 14 Sep 2023

²⁸ <http://links.giveawayoftheday.com/4ebooks.org>, accessed on 14 Sep 2023

²⁹ <https://www.free-ebooks.net/>, accessed on 14 Sep 2023

³⁰ <https://manybooks.net/>, accessed on 14 Sep 2023

³¹ <https://www.getfreebooks.com/>, accessed on 14 Sep 2023

³² <https://news.mit.edu/topic/massive-open-online-courses-moocs>, accessed on 29 Jul 2023

ability to transform higher education by boosting student outcomes and broadening learning options. Tuition has grown dramatically in recent decades, and the accompanying cuts have harmed students and limited access for lower-income students. MOOCs have the potential to significantly reduce university expenditures while also providing courses to students all around the world.³³ The most prominent MOOCs are Udacity, Coursera, and Edx. MOOCs recently took a big step forward when the American Council on Education (ACE) recommended 5 Coursera classes for accreditation. ACE membership consists of more than 1,800 universities.³⁴ Because of the suggestion, recognized colleges may soon be able to use Coursera points to help students finish their degrees. With a web camera, Coursera might charge a fee to make sure a student is who they say they are and to oversee a final test. ACE is currently working on a more thorough review of MOOCs, but the suggestion shows how big the changes that are coming will be.³⁵ Several colleges currently give students who finish MOOCs credit. The University of Washington (UW) was the first to offer MOOC classes. Through the Coursera platform, UW provides classes in applied mathematics, computer science, computational finance, and information security and risk management.³⁶ UW had previously offered certification programs through online classes and is now in the process of reformatting them for Coursera.³⁷ Additionally, San Jose State University (SJSU) and Udacity have partnered to provide college freshmen with an innovative remediation solution. At SJSU, fifty percent of undergraduates fail introductory courses in funda-

mental subjects. This causes bottlenecks in introductory courses and may result in students experiencing a postponement of their matriculation. SJSU provides credit-bearing courses in entry-level mathematics, college algebra, and rudimentary statistics via Udacity. The \$150 fee for Udacity courses is significantly less than the expense of a traditional credit. By dividing its courses into brief videos and exams, Udacity enables students to complete the coursework at their own pace.³⁸

MOOCs continue to march on to their disruptive journey in the field of higher education. President Obama had cited during the early years of MOOCs development that they had the potential to bring down costs of higher education, which remains a key concern among all stakeholders. MOOCs promise an alternate future to traditional education by keeping course material free but charging fees for assets such as certificates. Rising desire for cost-effective education, as well as an overloaded student population due to loan debt, continue to be important drivers of expansion in the vast open online course industry. The market for MOOCs is projected to grow at a rate of 33.1% from 2021 to 2026. This is because people still want to learn, and more and more business training programs are moving to online academies to meet this need. For example, IBM said that working with online schools for its business training led to huge improvements in learning and cut costs by 30%, which saved the company more than \$200 million. MOOCs have the potential to disrupt higher education, improving outcomes for students and expanding learning opportunities.

³³ Martin, Fred G. "Will massive open online courses change how we teach?." *Communications of the ACM* 55.8 (2012): 26-28, accessed on 13 Sep 2023

³⁴ "About the American Council on Education," 2013, Web: <http://www.acenet.edu/about-ace/Pages/default.aspx>, accessed on 13 Sep 2023

³⁵ Kolowich Steve, "American Council on Education Recommends 5 MOOCs for Credit." *The Chronicle of Higher Education* 7 February 2013. Web: <http://chronicle.com/article/American-Council-on-Education/137155/>, accessed on 29 Jul 2023

³⁶ "University of Washington Is First in U.S. to Provide Credit Classes and Certificate Programs on MOOC Platform." 18

July 2012. Web: <http://www.pce.uw.edu/newsroom.aspx?id=10865>, accessed on 29 Jul 2023

³⁷ Long Katherine, "UW to offer fee-based courses through Coursera." *Seattle Times* 18 July 2012. Web: http://seattletimes.com/html/local-news/2018714077_coursera19m.html, accessed on 29 Jul 2023

³⁸ Das Sumi, "Udacity, San Jose State University offer online classes for credit." 29 January 2013, Web: http://news.cnet.com/8301-1023_3-57566552-93/udacity-san-jose-state-university-offer-online-classes-for-credit, accessed on 29 Jul 2023



Figure 2: Success of MOOC39 and massive market growth of MOOC40

The University of Wisconsin-La Crosse developed a math MOOC. Using a \$50,000 grant from the Bill and Melinda Gates Foundation, UW La Crosse developed the open math course.⁴¹ UW La Crosse intended for the course to help high school students, those seeking remediation inside the University system, those planning to re-enter a university, and those prepared to take a major gateway test. The content is similar to that of the on-campus program MTH 051 Intermediate Algebra.⁴² This is something that a lot of other colleges want to do as well. Three main things all MOOCs have in common. The first is that it can be scaled almost infinitely. A single Coursera class had tens of thousands of people sign up.⁴³ MOOCs also have an open accessibility. There is no requirement for prior experience or qualification to enroll in a course. Also, there are no costs associated with taking a MOOC. Future-looking MOOCs will necessitate a business model. Possible choices include requesting monetary compensation from students in the form of tuition, certification test fees, course sponsorships, or staff recruiting. Finally, the technology that is used in MOOCs is a defining factor. They typically use free or open-source software, such as that found on Wikipedia or the Google Play store. Unlike the conventional paradigm, in which a small number of students pay a large sum in tuition, the large number of participants in MOOCs makes it possible to use a model in which each student pays just a modest amount.⁴⁴ The main advantage of MOOCs over traditional institution models is the potential for cost savings. Universities are confronted with a number of cost-cutting problems. Improving productivity is challenging due to Baumol's Cost Disease. According to economic theory, pay increases are accompanied by increases in worker productivity. However, in domains

such as education, productivity improvements have little noticeable impact on pupils. A poor professor can teach nearly the same number of students as a good professor, and both will have some outstanding pupils. Large lecture halls in academic institutions are expensive to maintain. MOOCs rely on low-cost open-source technology and can quickly scale. In an online context, the expenses of a million-student class are comparable to the costs of a hundred-student class. MOOCs might reduce the number of sections for popular beginning courses at universities, freeing up academics to teach other classes or do research.⁴⁵ The curricula of Udacity, Coursera, and Edx include retrieval exercises and intentional practice. In addition to facilitating constructivist learning, MOOCs employ formative assessments effectively. The pedagogical strategy of Coursera, which the company's founders Andrew Ng and Daphne Koller establish, is supported by research cited in their presentation on the platform. Effective teaching tools can be identified as "retrieval exercises" or active, cue-driven processes of knowledge reconstruction, according to the research of Jeffrey Karpicke and Janell Blunt. In determining whether retrieval or "elaborate learning" (i.e., conventional study methods) had a more significant effect on student proficiency, the authors conducted an investigation. One week after being instructed in the same lesson utilizing various techniques, the students were evaluated. A fifty percent enhancement in long-term retention scores was discovered as the benefit of retrieval practice in comparison to laborious studying with concept mapping. In an additional investigation, participants examined two distinct teachings. Students who utilized retrieval techniques to study

³⁹ <https://www.facebook.com/MOOC.edu/>, accessed on 29 Jul 2023

⁴⁰ <https://www.openpr.com/news/2279673/massive-open-online-course-mooc-market-to-grow-at-33-1-cagr>, accessed on 26 Jul 2023

⁴¹ "University of Wisconsin-La Crosse to develop math MOOC to boost college readiness and success." 13 November 2012. Web. <http://www.wisconsin.edu/news/2012/r121113.htm>, accessed on 26 Jul 2023

⁴² "College Readiness: University of Wisconsin System's Math MOOC." 2013. Web. <http://www.uwlax.edu/mathmooc/index.html>, accessed on 26 Jul 2023

⁴³ Adams, Susan. "Is Coursera the Beginning of the End for Traditional Higher Education?" Forbes 17 July 2012. Web. <http://www.forbes.com/sites/susanadams/2012/07/17/is-coursera-the-beginning-of-the-end-for-traditional-higher-education/>, accessed on 26 Jul 2023

⁴⁴ Rodriguez, C. Osvaldo. "MOOCs and the AI-Stanford like Courses: Two Successful and Distinct Course Formats for Massive Open Online Courses." Learning (2012), accessed on 13 Sep 2023

⁴⁵ Ruth, Stephen. "Can MOOC's and Existing E-Learning Efficiency Paradigms Help Reduce College Costs?." Available at SSRN 2086689 (2012), accessed on 13 Sep 2023

achieved notably higher scores on a short-answer examination.⁴⁶

Ng and Koller recognize Louis Deslauriers, Ellen Schelew, and Carl Wieman's contributions. The authors performed a study using two portions of an introductory physics class. One classroom employed standard teaching techniques, whereas the other followed the ideas of 'deliberate practice.' Deliberate practice is a constructivist and formative assessment-based concept. They discovered that students in the experimental section were more likely to participate and attend class.⁴⁷ MOOCs provide everyone access to learning possibilities. The benefits of giving pupils access to a classroom are immeasurable. MOOCs provide academics a way to share their theories with a broad audience. Distinguished academics may share their knowledge with learners worldwide through MOOCs. The ability to communicate with an almost infinite number of individuals will hasten the dissemination of information. MOOCs are going to attract more attention as the expense of attending university goes up. A new age in higher education is about to begin, one in which institutions will have unmatched reach. Modern classroom technology may increase learning possibilities and democratize knowledge. Students of the future will have access to a wealth of information through platforms like Edx, Coursera, and Udacity.

Minecraft

The internet changed the way professors and students shared knowledge. It gave instructors access to teaching standards, lesson plans, and extra resources.



Figure 3: Minecraft house idea and Minecraft legends

Minecraft is a popular "sandbox" computer game. It has no minerals, precious metals, water, or many other elements. Physics and chemistry are governed by fundamental principles. Players can collect natural resources to construct almost anything their mind can conceive. It is conceivable to construct working electrical circuits or coal-powered motors with the right resources. The game produces a fair representation of Earth, complete with abundant resources and natural laws.⁴⁹ Minecraft has several features that allow it to

Despite the magnitude of the shift, instructional technology has remained stagnant. The Internet has aided but not altered traditional teaching strategies such as lecture, group work, individual reading, and slide presentation. New technologies have given instructors new ways to instruct their pupils. Minecraft, a computer game, is the first step in that approach. Minecraft is a dynamic game with practically limitless customization options. Minecraft is a popular "sandbox" computer game. It is unfinished, having no clear storyline or game play objectives. Players approach the game in the same manner as children do with Legos or bricks. Minecraft's gameplay is deceptively basic. On the surface, players gather materials and construct things with them. Minecraft creates unique and massive worlds for its players. A Minecraft world has a cubic volume of two hundred sixty-two quadrillion, one hundred forty-four trillion "blocks." A Minecraft world would have a larger surface area than Neptune if each block has one-meter-long sides.⁴⁸ Numerous characteristics of the computer-generated environments in Minecraft resemble those of Earth. In addition to forest, desert, plains, wetland, jungle, icy plains, taiga, mountain, and ocean, Minecraft features more than a dozen biomes. Although each biome experiences climate-specific weather, the Earth as a whole maintains a regular day-night cycle. The world simulates gravity and watersheds accurately.

Every entity in existence is composed of blocks, encompassing various materials such as wood, earth, and so forth.

serve as a teaching tool. The game has a modification or mod called MinecraftEdu. MinecraftEdu gives teachers the tools to conduct a lesson in a virtual world. The mod allows teachers to place text around the world and control the location of students.⁵⁰ A community of teachers and educators has grown to support teaching on the Minecraft platform. They have created a dedicated Minecraft teaching wiki including lesson plans

⁴⁶ Karpicke, Jeffrey D., and Janell R. Blunt. "Retrieval practice produces more learning than elaborative studying with concept mapping." *Science* 331.6018 (2011): 772-775, accessed on 13 Sep 2023

⁴⁷ Deslauriers, Louis, Ellen Schelew, and Carl Wieman. "Improved learning in a large-enrollment physics class." *Science* 332.6031 (2011): 862-864, accessed on 13 Sep 2023

⁴⁸ Hafer, T.J. "Minecraft Infographic reveals total volume of one entire world." *PC Gamer* 6 February 2013 Web.

<http://www.pcgamer.com/2013/02/06/minecraft-infographic-reveals-total-volume-of-one-entire-world/>, accessed on 26 Jul 2023

⁴⁹ Short, Daniel. "Teaching scientific concepts using a virtual world—Minecraft." *Teaching Science-the Journal of the Australian Science Teachers Association* 58.3 (2012): 55, accessed on 13 Sep 2023

⁵⁰ MinecraftEDu." 2012 Web. <http://mine-craftededu.com/mod.php>, accessed on 26 Jul 2023

and research.⁵¹ Minecraft has a lot of promise as a way to teach. In social studies, students could build their own pyramid and face the same technical problems the Egyptians did as they did the pyramid. Students could act out scenes from books. Biology, physics, and chemistry teachers could show how things work in real time. Students can use constructivism to learn with Minecraft. Constructivist theory says that when students interact with their surroundings, they learn reliable knowledge by exploring on their own. As an educational playground, the Minecraft models help kids learn in a real way. MinecraftEdu has a brand-new learning resource. Jeffrey Adams teaches science to middle schoolers at the Crescent School in Toronto. Adams used Minecraft to teach about designing for the long term. Students were told to make a model of a city that could last for a long time and use little energy. There were a lot of students who decided to build their models online in Minecraft. Every student got to build their own city and was given a job to play, such as a farmer, builder, or miner. Adams wanted to know if using Minecraft would make students more interested and improve their work. To do that, he gave a poll both before and after the unit. Eighty-six percent of the kids said they would like to play the game at school again. Eighty percent thought that games made them more artistic and let them do things they wouldn't have been able to do otherwise. In general, the kids liked how freeing Minecraft was.⁵² Karen Yager and Andrew Weeding serve as educators at the esteemed Know Grammar School located in Sydney, Australia. Minecraft was employed as an instructional tool inside the classroom setting to facilitate the teaching of scientific concepts to a cohort of male students aged 12 to 13 years. The students were tasked with constructing a low-energy city model. The students were granted autonomy in selecting their preferred mode of presentation, with an overwhelming majority (96%) opting for the utilization of Minecraft. The participants were allotted a span of five days to construct their virtual urban centers, during which they were presented with daily tasks including the subjects of English, mathematics, science, and foreign language. This approach aimed to foster a multidisciplinary environment and maintain the students' concentration throughout the project. At the conclusion of the instructional day, the students proceeded to showcase their simulated urban landscapes. The researchers discovered that the male participants derived pleasure from the opportunity to engage in unstructured activities and undertake venturesome endeavors while operating within a framework of organization and guidance.⁵³

Professor Jessica Bayliss used Minecraft as a teaching platform in her class Game Artificial Intelligence (AI) at the Rochester Institute of Technology. The students enrolled in the course were required to generate novel terrains and non-player characters, among several other assignments. College and graduate students have the opportunity to significantly alter the game. The game's source code is written in Java, a widely used programming language. Furthermore, the broad modding community offered a platform for creative expression and a source of assistance. In previous instances, Bayliss had employed alternative software platforms for instructional purposes; nonetheless, it was seen that pupils had a more favorable response when Minecraft was utilized.⁵⁴ Bayliss found that using Minecraft increased student motivation for artificial intelligence through modding. She observes that a greater number of students are being requested to perform AI-related independent studies than in previous years. Students were free to use the Minecraft platform as well as their own imaginations. Minecraft succeeds as a game and as an instructive tool for the same reasons. It is based on a background that everyone is familiar with, such as natural laws. By keeping the game basic, participants may engage in actual learning. The constructivist foundation allows people of all ability levels, from elementary school to graduate students, to learn from the game. Teachers will benefit from innovative instructional technologies in this dynamic classroom. Learning possibilities will only grow as MinecraftEdu improves. 'Artemis: Rocket Build' is an example of MinecraftEdu, and it is a blast off to the moon with this superstellar terrain made in collaboration with NASA. Students may interact with scientists and engineers, learn about jet propulsion, and create a rocket.⁵⁵ They can test their creation with a fiery launch. So, students are learning from playing games and own creation. Artemis: Rocket Build has the following learning objectives⁵⁶:

- To learn about the Artemis program and its significance
- To use Newton's laws to understand how forces work and how these laws impact rockets' ability to fly.
- To learn about the parts of the Space Launch System and how propulsion and fuels are important to get the rocket off the ground and into space
- To better understand the Artemis missions (past, present, and future)
- To apply knowledge of Newton's Laws and a pre-set budget to assemble, design, paint, and launch a satellite, cargo rocket, and crewed rocket.

⁵¹ "MinecraftEdu Wiki." 2012 Web. http://minecraftedu.com/wiki/index.php?title=Main_Page, accessed on 26 Jul 2023

⁵² Adam, Jeffrey "Teaching Boys at the Coal Face: Mining Keep Pedagogical Approaches." Action Research Report (2012), accessed on 13 Sep 2023

⁵³ Yager, Karen and Weedings, Andrew. "Teaching Boys at the Coal Face: Mining Keep Pedagogical Approaches." Action Research Report Approaches (2012), accessed on 13 Sep 2023

⁵⁴ Bayliss, Jessica D. "Teaching game AI through Minecraft mods." Games Innovation Conference (IGIC), 2012 IEEE International. IEEE, 2012, accessed on 13 Sep 2023

⁵⁵ <https://education.minecraft.net/en-us/lessons/artemis-rocket-build>, accessed on 26 Jul 2023

⁵⁶ <https://www.youtube.com/watch?v=mG5xUN3oiKk>, accessed on 26 Jul 2023

An additional illustration of MinecraftEdu is 'Peace Builders'. Additionally, it offers fresh insights from four additional laureates and emphasizes conflict avoidance and resolution. A broader understanding of how to collaborate toward a more peaceful world will be imparted to the class.⁵⁷ Peace Builders was created as a creative and engaging introduction on how to build a better society. This experience will offer you with abilities that you may utilize to actively and successfully engage in society. It provides more possibilities to relive and learn more about the Nobel Peace Laureates and the improvements they brought about in the globe, therefore creating powerful and effective role models for society.⁵⁸ So, Those games or MinecraftEdu can test student's creation with a fiery launch. So, students are learning from playing games and own creation.

Learning Management System or LMS

2023 will be a big year for schools, businesses, and donors, with a focus on how to use data to make decisions. Schools will be smarter buyers, putting more weight on proof of effect from EdTech companies and using data to make smart choices about what to buy. More money will also be put into education study and testing how well edtech works. This trend is supported by both government spending and leaders in philanthropy. Companies that put study and proof at the center of their product development plans are more likely to make better goods that fit the market faster. Evidence-based approaches in EdTech should generally lead to better ways to boost student achievement and results. But only time will tell. That being said, we'll keep working on co-designing the future of EdTech for now.⁵⁹ EducateMe LMS is an excellent choice for operating bootcamps since it has an easy-to-use interface for creating and managing courses, classes, and bootcamp content. EducateMe enables bootcamp course designers to easily construct customized curriculums with varied lessons in a single site. Instructors may quickly upload lesson notes, offer homework projects via quizzes and exams, deliver live lectures, and track each student's progress. Everyone has heard of a Learning Management System, or LMS. Learning is at the heart of any educational or training program delivered by an individual. Management is the branch of the learning program that controls all of the schedules for each participant. The system is just an e-platform for delivering learning modules.⁶⁰

LMS is designed to help an individual to develop, manage and provide online courses and programs to learn.⁶¹ Additionally, it gives students and teachers a place to learn and show off their skills whenever and wherever they choose. Learning Management Systems (LMS) are programs that are used to run, keep track of, report on, and offer learning programs. LMS is used by

almost all of the big markets, including schools, businesses, the medical field, and more. Checking each person's work on quizzes and tests can help you figure out where the communication gap is between the teacher and the student. With video lessons, stories, and features like games, etc., learning online is more fun.⁶² Every individual on the planet's learning viewpoint has been altered by LMS. It has expanded the options for people to study and learn in whichever sector they desire to succeed in, as all material can now be shared globally. Nowadays, practically all corporations and organizations, all educational institutions (schools and universities), many government agencies, and private tuition and institutes utilize LMS. LMS addresses all of the primary learning challenges that each individual face, as listed below.

Employee training is available in any field, whether it be software, educational, corporate, or government. We need to teach staff according to our demands, which LMS can simply achieve. It automates the majority of the tasks. Tracks people's development, saving employers a significant amount of time and money. We may construct learning programs, courses, and tutorials in LMS and publish them so that anybody can use them to improve their skill set. These are useful when an employee leaves the organization or retires to ensure that the expertise is preserved. We may educate the general population by developing awareness initiatives and tutorials on a variety of topics. LMS is an open platform for individuals and professionals to learn and demonstrate their talents. Students can choose learning programs, and experts can teach learning courses. It gives its users the freedom to learn from anywhere. On a public note, it shares discussion forums. Users may simply study the topic of their choice, and the fee is relatively low in comparison.

LMSs give an all-in-one platform for learning and skill development. It offers a plethora of online courses from which the customer may select according to their preferences. It aids in the tracking of an individual's development progress. It minimizes the expense of learning as well as travel and space preparations. LMS helps to streamline the learning pattern, which saves time for teachers, allowing them to focus more on each individual's progress. Everything becomes digital, which saves a lot of money on notebooks, copies, and so on. It allows the user to study from anyplace and hence promotes mobility. Learning gets more exciting as things become more digital, thanks to the availability of video lessons, clips, gamification, and so on. With LMS, simple and effective administration is feasible, and information access is rapid and accurate. Although LMS has many advantages, it also has several drawbacks. The most significant disadvantage of online learning is that many tasks that must be completed physically cannot

⁵⁷ <https://education.minecraft.net/en-us/lessons/peace-builders>, accessed on 26 Jul 2023

⁵⁸ <https://www.youtube.com/watch?v=t-QIJW5OnM>, accessed on 26 Jul 2023

⁵⁹ <https://www.leanlabeducation.org/blog/edtech-research-predictions/>, accessed on 13 Sep 2023

⁶⁰ <https://www.softwaretestinghelp.com/learning-management-system/>, accessed on 13 Sep 2023

⁶¹ <https://www.softwaretestinghelp.com/best-online-course-platforms/>, accessed on 11 Sep 2023

⁶² Robson K., et al, (2015), "Is it all a game? Understanding the principles of gamification", *Business Horizons*, 58 (4): 411–420. doi:10.1016/j.bushor.2015.03.006, accessed on 11 Sep 2023

be completed. Because no gathering is necessary for learning, the impact of face-to-face connection is diminished. It enhances the tunnel effect of learning, which reduces the breadth of broad thinking and causes the user to only see through the LMS, leaving numerous chances outside. Some pupils require motivation and encouragement to study, which will be lacking, resulting in credibility concerns.

Robot Assisted Language Learning (RALL)

One of the goals of Human-Robot Interaction (HRI) is to research and develop autonomous social robots as tutors that are able to support children learning new skills effectively through repeated interactions. To achieve this, the interactions between child and robot should be pleasant, challenging, and pedagogically sound.⁶³ Interactions must be enjoyable for children, demanding so that they remain motivated to master new abilities, and pedagogically sound so that children get information that maximizes their learning gain. Second language (L2) teaching is one arena in which robots for learning are being developed. While great work has been achieved in this sector, no effective one-on-one L2 tutoring program has been developed that can be systematically implemented in educational settings for multiple linguistic groups.⁶⁴ More attention is being paid to how social robots might help kids stay interested in learning tasks. Researchers have found that robots help kids connect with each other more in bigger classrooms, which leads to better language learning.⁶⁵ How best to apply this knowledge in the teaching of a foreign language has been explored by different researchers from various perspectives. Alemi et al. employed a social robot as an assistant to a teacher over a 5-week period to teach English vocabulary to Iranian students.⁶⁶ They found that the class with the robot assistant learned significantly more than that with just the human teacher. In addition, the robot-assisted group showed improved retention of the acquired vocabulary. This builds on earlier findings by⁶⁷ where a 2-week study with a robot situated in the classroom revealed a positive relation between interacting with a robot and vocabulary acquisition. Further results by⁶⁸ also confirm

that the presence of a robot leads to a significant increase in acquired vocabulary. Movellan et al. selected 10 words to be taught by a robot, which was left in the children's classroom for 12 days.⁶⁹ Children demonstrated a considerable increase in the quantity of learnt words when taught by the robot at the end of the research. Lee et al. further shown that robot tutoring may increase not just vocabulary but also speaking abilities. Children would begin their studies with a computer-delivered instruction, followed by pronunciation training with a robot.⁷⁰ The robot would detect words with an expanded lexicon based on commonly confused phonemes and correct the child's pronunciation. Additionally, the children's confidence in learning English was improved.⁷¹ All of these studies show the capacity of various robots as tutors for children (with the children's age ranging from 3 to 12 years old) learning an L1 or L2 'in the wild'.⁷² While the benefits of social robots in tutoring are clear, there are still a range of open issues on how robot tutors can be effectively deployed in educational settings.⁷³

Historically, education institutions have been hampered by a shortage of qualified second language teachers. However, new technologies have the potential to transform the way pupils learn new languages. Learning a new language involves a lot of practice and memory. Language grammar and vocabulary give a specified framework. These circumstances enable robots to give outstanding assistance in secondary language acquisition. Researchers from the Korean Institute of Science and Technology's Center for Intelligent Robotics (CIR) and Pohang University of Science and Technology (POSTECH) created two robots to act as English teaching assistants. They developed two distinct models, MERO and Engkey. Engkey is an abbreviation for English Disc Jockey and resembles a large penguin.⁷⁴ Some Engkey models have faces that are meant to look like they are feeling different moods. Some have a screen that lets teachers use a phone to talk to students in another room. It is hard to find skilled English teachers to work on islands or in rural places in

⁶³ Tanaka F, Matsuzoe S (2012) Children teach a care-receiving robot to promote their learning: field experiments in a classroom for vocabulary learning. *J Hum Robot Interact* 1(1):78–95, accessed on 13 Sep 2023

⁶⁴ Käser T, Klingler S, Schwing AG, Gross M (2014) Beyond knowledge tracing: modeling skill topologies with bayesian networks. In: *Proceedings of the 12th international conference on intelligent tutoring systems*. Springer, Berlin, accessed on 13 Sep 2023

⁶⁵ Fridin M (2014b) Storytelling by a kindergarten social assistive robot: a tool for constructive learning in preschool education. *Comput Educ* 70:53–64, accessed on 13 Sep 2023

⁶⁶ Alemi M, Meghdari A, Ghazisaedy M (2014) Employing humanoid robots for teaching english language in Iranian Junior High-Schools. *Int J Hum Robot* 11(3). <https://doi.org/10.1142/S0219843614500224>, accessed on 13 Sep 2023

⁶⁷ Kanda T, Hirano T, Eaton D, Ishiguro H (2004) Interactive robots as social partners and peer tutors for children: a field trial. *J Hum Comput Interact* 19(1):61–84, accessed on 13 Sep 2023

⁶⁸ Tanaka F, Matsuzoe S (2012) Children teach a care-receiving robot to promote their learning: field experiments in a

classroom for vocabulary learning. *J Hum Robot Interact* 1(1):78–95, accessed on 13 Sep 2023

⁶⁹ Movellan JR, Eckhardt M, Virmes M, Rodriguez A (2009) Sociable robot improves toddler vocabulary skills. In: *Proceedings of the 4th ACM/IEEE international conference on human-robot interaction*, accessed on 13 Sep 2023

⁷⁰ Lee S, Noh H, Lee J, Lee K, Lee GG, Sagong S, Kim M (2011) On the effectiveness of robot-assisted language learning. *ReCALL* 23(01):25–58, accessed on 13 Sep 2023

⁷¹ Saerbeck M, Schut T, Bartneck C, Janse MD (2010) Expressive robots in education: varying the degree of social supportive behavior of a robotic tutor. In: *Proceedings of the SIGCHI conference on human factors in computing systems*, ACM, accessed on 13 Sep 2023

⁷² Vogt P, de Haas M, de Jong C, Baxter P, Krahmer E (2017) Child-robot interactions for second language tutoring to preschool children. *Frontiers in Human Neuroscience* 11, accessed on 13 Sep 2023

⁷³ <https://link.springer.com/article/10.1007/s12369-018-0467-6>, accessed on 29 Jul 2023

⁷⁴ Sang-Hun, Choe. "Teaching Machine Stick to Script in South Korea" *Time* 10 July 2010: n. page. Web. 15. February 2012, accessed on 13 Sep 2023

South Korea, as it is in many developing countries. Teleconferencing makes it possible for classes that are in different places to work together. Engkey can move around the classroom and talk to kids because he has "stereo vision."⁷⁵ MERO meanwhile is a "head only" robot. It looks closer to popular depictions of a robot with large eyes and colorful exaggerated features. The head is able to rotate on a plastic base. The robots look friendly and non-threatening to children. In 2010 Engkey cost about \$8,700, but the Korean government hopes to bring that price down as production increases.⁷⁶ The Korean Education Ministry hopes to establish an English language robot in each of the country's 8,400 kindergartens by the end of 2013.

MERO and Engkey communicate using powerful voice recognition software. The robots employ transcribed Korean children's speech and audio recordings from the Wall Street Journal. The system contains noises that Koreans are prone to misidentify as the right phoneme. To account for unforeseen errors, the system may deduce what the speaker intended to say statistically based on the type of the error and the context of the phrase. The algorithm develops and scores a number of hypotheses regarding the speaker's intended word choice.⁷⁷ The ranking process lets the robots understand and improve the speech of young people who are learning a new language. One of the best things about the language recognition system is that it can find and fix mistakes made by speakers. Speech recognition software had a hard time in the beginning because speakers made mistakes that were hard for computers to understand. Every robot has a set of error rules that help it deal with mistakes that are likely to happen. One example is that the system stores all of the English vowel and consonant sounds (phonemes). MERO and Engkey use RavenClaw to keep track of their conversations.

Conversation trees at the Korean Institute of Science and Technology's Center for Intelligent Robotics enable robots to generate hierarchical maps. The electronic processor contains stop and turn-taking procedures that make discussions sound natural. The system contains several produced talks for students to practice with. Engkey may also use RavenClaw to correct English language learners' grammar, pronunciation, and vocabulary.⁷⁸ The system can tell what kind of mistake the

person is making and give them tips on how to fix it. RavenClaw can look through an Example Expression Database, pick out a phrase that sounds most like what the speaker means, and then fix them. The system gives kids praise if they use correct grammar and have real talks. MERO and Engkey talk to kids through speech protocols and body movements as well. They have different faces that show different emotions, such as tolerance, dislike, hope, fear, joy, pain, surprise, shame, and sadness.⁷⁹ Engkey can also verbalize facial emotions and movements to wink, yawn, applaud, and pout. Conversations become more real as a result of the expressions. When the robots correct or laud a learner, they employ the appropriate social expression. Emotional expression is a crucial component of verbal communication because it adds context to talks. MERO and Engkey's creators investigated the efficacy of robot-assisted language learning (RALL). The study involved 21 pupils in grades two through six from a South Korean elementary school. Based on pre-test scores, they were divided into starting and intermediate groups. The pupils were all from South Korea and spoke Korean as their first language. None of the pupils had spent more than three months in an English-speaking nation. Lesson plans were created by the researchers for both the beginning and intermediate classes. The class focused on discussions suited for supermarket and stationery store buying. Students completed a post-test in addition to the pre-test to assess the cognitive impact of RALL on listening and speaking abilities. A 15-item multiple-choice exam was used to measure listening ability. They performed one-on-one interviews to demonstrate progress in speaking abilities. Ten tasks were included in the procedures to assess speaking abilities. The rubric graded pronunciation, vocabulary, grammar, and conversational competence on a five-point scale. According to the findings, RALL improves student speaking but not listening abilities. The post-test scores of the students were statistically considerably higher than the pre-test results. RALL had a substantial impact size on speaking abilities, ranging from 0.86 to 0.9 standard deviations. If the average student who benefited from the intervention began with ordinary skills, the results indicate that they would finish considerably above average, scoring higher than eight out of ten usual pupils.

⁷⁵ Lee, Sungjin, et al. "Cognitive effects of robot-assisted language learning on oral skills." INTERSPEECH 2010 Satellite Workshop on" Second Language Studies: Acquisition, Learning, Education and Technology. 2010, accessed on 13 Sep 2023

⁷⁶ Horn, Leslie. "South Korean Schools Testing Robot Teachers." PC Magazine 28 Dec. 2010: n. page. Web. 15. February 2012, accessed on 13 Sep 2023

⁷⁷ Lee, Sungjin, et al. "Affective effects of speech-enabled robots for language learning." Spoken Language Technology Workshop (SLT), 2010 IEEE. IEEE, 2010. B, accessed on 13 Sep 2023

⁷⁸ <http://billemmott.com/wp-content/uploads/2016/01/EducationBrookings.pdf>, accessed on 29 Jul 2023

⁷⁹ <http://www.cnn.com/2010/TECH/innovation/10/22/south.korea.robot.teachers/index.html>, accessed on 29 Jul 2023



Figure 4: Student practices her English pronunciation with a robot at South Korea's (MERO⁸⁰ and Engkey⁸¹)

Most people who are learning English as a foreign language (EFL) don't have enough chances to say English. But the rise of social networking sites (SNSs) and mobile learning, especially mobile-assisted language learning, has given these English learners new ways to practice speaking English in a useful way.⁸² A research conducted by the Center for Intelligent Robotics at the Korean Institute of Science and Technology found no statistically significant variations in listening abilities. Several variables, according to the academics who did the evaluation, may have impacted this finding. One hypothesis is that the text-to-voice components were insufficient to accurately simulate speech. Students who took part in prepared chats might have been reading the script rather than responding to the robot. It's also likely that the robots' non-human sound effects had a detrimental impact on understanding. Students said that they enjoyed their time in class using MERO and Engkey. KIST researchers devised a survey that students completed both before and after the intervention to assess student attitudes. The poll consisted of 52 items, with responses given on a 4-point Likert scale ranging from strongly disagrees to strongly agrees. Students who completed the program were far more likely to agree with the statement 'You are interested in English.' Student confidence grew during the curriculum as

well. They were more likely to say, "You can greet foreigners with confidence" and "You believe you can speak English better if you study harder." Students indicated improved enthusiasm to learn English as well. They were more inclined to agree on the statements 'You wish to learn English more' and 'You spend more time learning English by yourself.' Overall, the students had a good experience with MERO and Engkey. The Secondary Language Acquisition (SLA) theory explains why RALL is effective in improving speaking abilities. According to SLA theory, four competencies are required to develop communication skills: intelligible input, comprehensible output, corrective feedback, and motivation. The RALL classes placed new terms in familiar contexts, which made learning easier. MERO and Engkey's corrective feedback and praise assist students build good speaking abilities. With context-supported teaching, RALL enables students to generate new constructs. In summary, RALL is a potent assistive technology with a proven impact. A shortage of trained secondary language instructors is expected to exist in the future, and teachers will require assistance in teaching the next generation of pupils. Students may engage in genuine dialogues with the help of robots. MERO and Engkey's performance in South Korea indicate how robots may improve student learning.



Figure 5: Advanced digital world and Social robots as second language tutors

⁸⁰ <http://edition.cnn.com/2010/TECH/innovation/10/22/south.korea.robot.teachers/index.html>, accessed on 29 Jul 2023

⁸¹ <https://www.voanews.com/a/south-korean-students-learn-english-from-robot-teacher-117640783/167151.html>, accessed on 13 Sep 2023

⁸² https://www.researchgate.net/publication/316061891_Improving_the_English-speaking_skills_of_young_learners_through_mobile_social_networking, accessed on 29 Jul 2023

Computerized Adaptive Testing (CAT)

Standardized tests haven't changed much in terms of technology in the last fifty years. Psychometricians have made some progress in writing items and making tests. But the paper-based test (PBT) with an electronic answer sheet has been around for a long time. Because it is more accurate and useful than standard test formats, computerized adaptive testing has the ability to shake up a field that has been stuck for a while. PBTs have a lot of problems. To be able to pass a PBT, you might need skills that don't directly show how well you know a subject. Someone with dyslexia might be very good at math, but they might have trouble reading test questions. A student who has trouble controlling their small motor skills might find it hard to fill in test boxes

even though they may know a lot about the subject. It is easy to make mistakes and costs a lot to grade PBTs. Standardized tests are expensive because millions of paper tests have to be printed, stored, delivered, and picked up. It's very hard to organize everything needed to grade handwriting writings. To make matters worse, the PBT structure makes it easy to cheat. Cheating on standardized tests is a problem that hasn't been studied enough. But it seems likely that more cheating will happen as more people with a stake in education see their own financial futures depend on test grades. To get tests, schools have to spend a lot of money and time. These problems are built into the PBT system and are hard to fix.



Figure 6: CAT becoming successful testing⁸³ and benefit of CAT⁸⁴

Computerized adaptive testing (CAT) is a testing method that dynamically adjusts to the unique skill level of each test taker. For instance, when a test taker responds accurately to a question in an examination, they will thereafter encounter a more challenging question. Alternatively, in the event that the individual answers the aforementioned question incorrectly, they will be provided with a less complex question. Put simply, the subsequent question is chosen solely based on the evaluation of the performance on the preceding question. Traditional or linear examinations classify problems into several levels of complexity. As an illustration, in the assessment of English language ability, the Common European Framework of Reference for Languages (CEFR) is employed, which has six distinct levels. In order to provide a more balanced assessment, it is advisable to allocate a greater number of questions or assign a higher weight to the intermediate difficulty levels, while reducing the number of questions at the extreme ends, namely the beginner and advanced levels. Examinations conducted using the conventional approach need a substantial number of questions. One major English proficiency test asks 200 questions in an exam that lasts 150 minutes. The testing company experiences advantages in terms of time efficiency since the expenses associated with applicant seat time are significantly decreased. This implies that they have the capacity to conduct further experiments within a certain timeframe.⁸⁵

Adaptive testing makes an exam unique for each person by looking at how they answer questions. The questions come from a big database. When someone takes a test and does well, they are given more tough questions. When someone does poorly, they are given easier questions. The number of questions is another part of adaptable tests that can be changed to fit the test taker's needs. After a certain point is reached, the test will be over. The purpose of adaptive tests is to help with hiring people in a wide range of fields, from schools to businesses. Adaptive testing lets teachers improve current test banks, make sure exams are in line with school and program standards, get more information to help both students and teachers, and improve their teaching methods in ways that are sensitive to different cultures. Adaptive testing has a lot of good points. This testing tool helps both the companies that give the tests and the people who take them. Researchers have found that CAT can cut test time by at least half. This can help cut costs by a lot, especially for businesses that pay for seat time at training centers. Adaptive tests give managers data right away. In the classroom, this means that teachers can use test results to improve their lessons and the way they teach each student. For hiring reasons, it gives a clear picture of a candidate's skills more quickly than standard tests.

In adaptive testing, each person may see different things, but they are all scored on a percentile scale that takes into account how hard the questions are. This tells teachers how skilled each kid is. In the same way, it lets

⁸³ <https://www.englishatvantage.com/cambridge-computer-adaptive-testing>, accessed on 26 Jul 2023

⁸⁴ <https://adaptivex.io/benefits-of-adaptive-testing/>, accessed on 26 Jul 2023

⁸⁵ <https://www.youtube.com/watch?v=ABASwzrETbw>, accessed on 26 Jul 2023

companies compare the skills of each candidate fairly. That's right—because they use big testing pools, adaptive testing is more effective and lets the company make the test more accurate than a regular test. In the end, teachers will have a good idea of how each student is doing and what they need. In the same way, companies get a clear picture of which candidates are skilled and which ones are not. When companies want to improve their current workers, adaptive testing helps them find skill gaps, set priorities for employee growth, and get the most out of their investment. Because each person taking an adaptive test is pushed in the right way, the experience is better generally than a standard test. Low performers won't be put off or scared, and high performers won't get bored and might even enjoy getting harder things. The experience of taking a better test will make students of all levels work harder than they might on a regular test. High performers will be pushed in a good way, and low performers will feel more at ease. Again, adaptive test algorithms are very adaptable and can have millions of different versions. This makes them much safer than giving a group of people a standard test with X number of questions. Because an adaptable test comes in so many forms, it can be taken more than once. If a student has trouble on a CAT, the teacher can make sure they get the right kind of help. When the student is ready, they can take the test again and get a totally different test. The student can keep getting better at what they do this way. Administrators can use different kinds of voice, video, and images in adaptable tests because they are computer-based. For businesses, this means they can make the test fit the subject and the people taking it in the best way possible.

There is a recognition that each individual learns and tests differently. It is critical for educational institutions to address the requirements of all students, which is why adaptive testing can be so beneficial in assisting teachers in aiding their pupils. In terms of human resource solutions, CAT can assist speed up the hiring process so that neither the business nor the candidate wastes time. In reality, adaptive assessments are an excellent approach to improve individuals and boost a company's overall growth. CAT is a hybrid of two ancient technologies: computers and adaptive algorithms. The Stanford-Binet IQ Test, developed in 1905, was the first to adjust test material to the test taker.⁸⁶ These two methods are used together in modern CAT tests. CAT picks test questions based on how a person answered earlier questions. A lot of different schooling groups use CAT effectively. The Graduate Records Examination (GRE) and the Graduate Management Admission Test (GMAT) can now be taken in CAT style by graduate students. CAT is used in Idaho, South Dakota, Oregon, and Delaware right now. Delaware is the only state that uses CAT to hold people accountable.⁸⁷ The

new Common Core State Standards (CCSS) examinations will also include CAT. The Smarter Balanced Assessment Consortium has committed to adopting CAT, but the Partnership for Assessment of Readiness for College and Careers (PARCC), the other CCSS consortia, has elected to employ fixed form examinations. The CAT offers more trustworthy test results than the PBT. Each student receives the identical set of questions on PBTs. PBTs provide a good overview of performance for the majority of students (those who are average). However, there is evidence of decreasing dependability for pupils at the extremes of the distribution (extremely strong and very weak students). CATs offer better questions than PBTs and tailor test items to the student's ability level. If the test taker properly answers a question, the following question becomes more difficult, and if he or she poorly answers a question, the next question becomes simpler. When the complexity of the item closely matches the student's knowledge, test scores are more reliable. To adequately assess pupils, examinations must include 'Goldilocks' things: objects that are neither too difficult nor too simple, but are just right for the student's ability level. Consider an average 8th grade math student who subsequently takes 7th and 9th grade math tests. The pupil will most likely perform extremely well on the 7th grade test and extremely poorly on the 9th grade test. Unfortunately, none of those ratings provides a solid indication of the pupils' 8th grade math competence. A better test results from test items with a suitable level of difficulty.

Researchers have confirmed that CAT scores have greater reliability than PBT at the extreme ends of the distribution. Gage Kingsbury and Carl Hauser compared 'test information and measures of score accuracy and classification between fixed and adaptive forms of 4th and 8th grade reading and mathematics tests and noted that information at the extremes of the ability distribution was three times greater in the adaptive setting.'⁸⁸ In another study of CAT in Oregon, Tony Alpert found smaller standard errors for CAT than for PBT at the tail ends of the distribution.⁸⁹ When tests are reliable, students can be more sure that they would get the same score if they took the test again. It's not very reliable and doesn't tell you much if a student does well on one test and then fails a similar one later on. When lawmakers make test scores more important, the value of dependability only goes up. Giving the CAT is a lot cheaper than giving the PBT. Gary Phillips, Vice President and Chief Research Scientist at the American Institutes for Research, told Congress that he thought CAT was half as expensive as PBTs. Phillips said that the price of PBTs was too high because of the costs of

⁸⁶ "First Adaptive Test." 2012 Web. <http://iacat.org/node/442>, accessed on 26 May 2023

⁸⁷ Wang, Shudong, et al. "Construct Validity and Measurement Invariance of Computerized Adaptive Testing: Application to Measures of Academic Progress (MAP) Using Confirmatory Factor Analysis." Online Submission (2012). Web. <www.doe.k12.de.us/dcas/files/Vol4_RelVal_Report.pdf, accessed on 26 May 2023

⁸⁸ Quoting Stone, Elizabeth, and Tim Davey. "Computer-Adaptive Testing for Students With Disabilities: A Review of the Literature." (2011), accessed on 13 Sep 2023

⁸⁹ Alpert, Tony. "A coherent approach to adaptive assessment." National Academies, Board on Testing and Assessment and The National Academy of Education Workshop, Best Practices for State Assessment Systems, Washington, DC. 2010, accessed on 26 May 2023

printing, sending to schools, and marking them.⁹⁰ The Brown Center on Education recently estimated that states spent roughly \$1.7 billion on standardized testing each year.⁹¹ Schools may incur more expenditures in the short term as a result of updating or acquiring computers. However, in the long run, schools will save a lot of money. CAT takes pupils less time to complete, freeing up teaching time during the school day. Walter Way

discovered that CAT requires fewer test items to obtain the same degree of accuracy as PBT. When questions are personalized to the test taker, time is saved and unnecessary simple or difficult questions are avoided. Way discovered that some adaptive exams may be completed forty to fifty percent faster than paper tests.⁹²

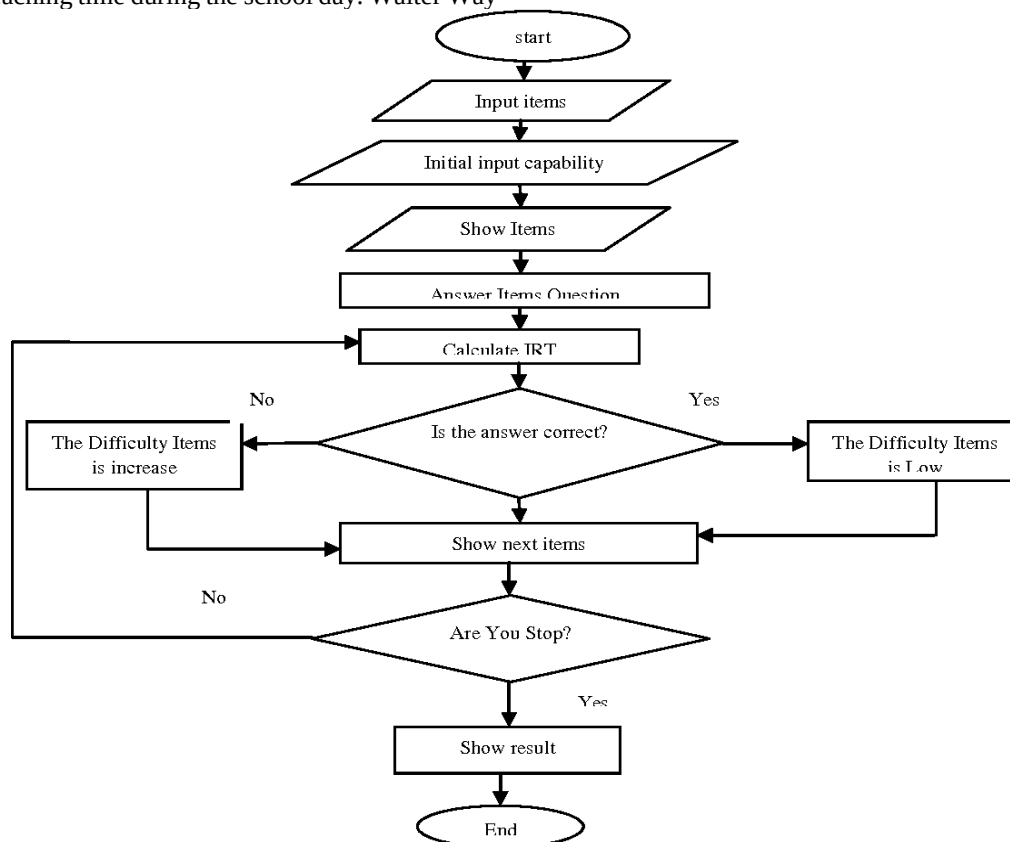


Figure 7: Follow diagram of Computerized Adaptive Test (CAT)⁹³

Policymakers like the idea of spending fewer minutes on tests because American schools don't have enough time to teach. One more benefit of CAT is that it lets you include test questions that boost trust. Students get nervous when they have to take tests. Standardized tests should have high stakes, but stress can also make it harder to do well in school. CAT keeps track of students throughout the test, so it can include things that boost confidence that aren't scored. There aren't any groups or states that use test things in this way, but it would be easy to add them. Joshua Hausler and Markus Sommer looked into things that boost confidence and found that students had more self-confidence when they had motivation items. Also, they couldn't find any proof that adding these things to the test changed the results.⁹⁴ With minimal drawbacks, including confidence-boosting products has the potential to help re-

duce test anxiety. Another advantage of CAT is its simplicity of usage for special education pupils. Many children with disabilities might demonstrate competency on paper-based assessments, but they would need accommodations such as a reading assist to do so. Text to speech, voice to text, and test item magnifying are all simple tasks for computers. Simple modifications might allow many kids to engage in the same accountability systems as their peers in general education. This saves resources while also holding all pupils to the same standard. For decades, PBT was the dominating test format. Computers have advanced to the point that they now provide a considerably greater platform. They provide more precise evaluation for less money. CAT frees up important instructional time while also reducing student anxiety. Student test scores are being used by an increasing number of education stakeholders to drive policy decisions ranging from school closures to

⁹⁰ Phillips, Gary W. "Testimony for the US Senate Committee on Health, Education, Labor and Pensions." (2010)

⁹¹ Chingos, Matthew M. "STRENGTH IN NUMBERS." (2012), accessed on 13 Sep 2023

⁹² Way, Walter D. (2010, June), Some perspectives on CAT for K-12 assessments. Presented at the National Conference on Student Assessment, Detroit, MI, accessed on 13 Sep 2023

⁹³ <https://www.semanticscholar.org/paper/Computerized-Adaptive-Test-based-on-Item-Response-Kusti-yahningsih-Cahyani/,> accessed on 13 Sep 2023

⁹⁴ Hausler, Joachtm, and Markus Sommer, "The effect of success probability on test economy and self-confidence in computerized adaptive tests," *Psychology Science* 50.1 (2008): 75, accessed on 13 Sep 2023

tenure awarding. As this tendency continues, education stakeholders make an unspoken commitment to administer credible examinations. As a result, employing CAT is part of keeping that commitment.

Stealth Assessments

An important part of good teaching is measuring how much students have grown. Formative and final tests are the two main types of tests. Formative tests are usually given during a unit or lesson. These tests find out what a student is good and bad at so the teacher can change how they teach. Summative evaluations are tests at the end of a unit that give students feedback. There is a small difference that depends on what the teacher wants to draw from the data or how they plan to use it. When it comes to generality, final tests are very important. In this case, a student will not get a diploma if they fail the graduation test. Formative tests aren't always low-stakes, but sometimes they are. They allow you to change your direction in the middle of your trip without being punished. The information that initials evaluations give teachers is very important for good teaching. Standardized tests and formative tests have a lot of the same problems. Another thing that takes time away from teaching is giving initial exams. Creating tests that are useful for a class and not just for testing students' knowledge takes time and skill. To get the most out of initial exams, you need to think about what your students need and then change how you teach in the future. Formative assessments are strong training tools, but they require a lot of time and money. The use of stealth tests is a big step forward in test technology. Formative tests are hidden in games as "stealth assessments." Professor Valerie Shute at Florida State University and her colleagues created the first secret test. They didn't mean to trick students, but rather to collect data in a way that wasn't obvious.⁹⁵ They gather data on student learning, which teachers may subsequently utilize to improve and personalize education. Shute has uncovered several advantages to stealth evaluation. Stealth assessment addresses certain well-known educational resource issues. The low stakes situation brings benefit in terms of psychometrics. Psychologists have long recognized that seeing how youngsters play provides insight into the learning processes. Students' behavior changes as the stakes are raised, and they utilize different tactics to solve problems in a sandbox than they do when taking the SAT. Because students' behavior varies when engaged in a game rather than when concentrating specifically on an evaluation, stealth assessments collect different data than high stakes tests. Another advantage of games is the way they inspire pupils. Games immerse the player in a narrative, and the player becomes an integral part of the plot. Playing games encourages kids to push themselves even when they face difficulties. Paper and pencil tests, on the other hand, do not encourage students. Students' willingness to play stealth assessment games outside of the

classroom might be a big help to instructors since it would give data without taking up classroom time.

Students are learning English in places all around the world. Because of poverty or geographic remoteness, many of these schools lack trained English teachers. Engkey not only supplements language instruction but also connects teachers and students. Monitors in new Engkey versions allow teachers to teleconference from anywhere in the world. Almost every school now has access to highly competent language instructors thanks to Engkey. MOOCs can help universities break through enrollment barriers for entry-level survey courses. In six years, slightly more than half of students graduate from four-year public institutions.⁹⁶ One reason for this sad figure is that the courses needed to graduate are not available. Because a class is full, students shouldn't have to pay for the whole semester's fees. MOOCs give students more freedom and get rid of the red tape that keeps them from finishing on time. Lawmakers need to change privacy rules so that data from games played outside of school can be collected. This information should be stored in current education data systems, so districts should make tools to do that. Teachers need to talk to parents to get permission to record data from the games their kids play and use it in evaluation tools. These changes will make sneak reviews more useful. Leaders should base budget choices on real-world study. Costs can be cut by making smart choices after evaluating them. One thing that makes the tools in this study stand out is that they can collect data. As soon as "big data" is available, there will be a huge amount of study in education. Collecting the data is the main thing that stops those sets from being made. Using new tools will make it easier to collect data that can be used to improve teaching and show which programs work best. Schools can save money by getting rid of services that don't work. Policymakers should think about more than just how much a new technology cost. They should also think about how it could change things. A truly meritocratic school system can be made with technology. We think that kids need the same amount of time to learn the same things in the status quo. If a student can show that they understand a college-level physics class through self-directed learning, then making them spend hundreds of hours in a high school class is not a good idea. New testing tools can more accurately find out how well a student has learned. This means that judges will have even more chances to collect data from games and other tests. A more merit-based education system will be possible if students have more chances to learn and show what they can do. Students are not expected to do well on assessments. No matter what kind of background a student has, they can use technology to get credit for their work.

⁹⁵ Shute, Valerie J. et al, (in press). Measuring and supporting learning in games: Stealth assessment, White paper for MIT series, published by the MacArthur Foundation, Web,

<http://myweb.fsu.edu/vshute/pdf/white.pdf>, accessed on 26 May 2023

⁹⁶ <http://nces.ed.gov/ipeds/>, accessed on 26 May 2023



Figure 8: AI in student assessment⁹⁷ and Stealth assessment⁹⁸

Analysis of Teacher and Teaching Method

Teaching is a complex job that includes a number of rote but time-consuming tasks. Tools that facilitate the memorization of basic facts free up teachers to help students who need personalized interventions. Every extra minute spent teaching makes a difference over the course of the school year.⁹⁹ New developments in testing technology might be good for both teachers and students. That way, teachers won't know if their students have understood the lesson and lawmakers won't know if their changes have worked. Since the optical scan answer sheet was first made fifty years ago, assessment technology hasn't changed much, if at all. New tools for testing can help lower the cost of testing, and some of them let tests be given accurately in real time. Thanks to improvements in tests, students can be graded in a setting with low risks. In the past few years, it has been suggested that social robots could be used to teach and guide both kids and adults. Robots have been shown to be good at teaching both facts and skills. Now we want to look into how social robots can be used to help young children learn a second language. As situated, grounded, and social learning are all important parts of language learning, and contact and repeated practice are at the heart of all three, social robots have a lot of potential as teaching tools to help people learn a second language (L2).¹⁰⁰ Cheating on tests and a lack of understanding into student comprehension of a class are two major issues that instructors confront nowadays. This is also the most significant issue with online assessments, because professors sometimes do not know whether pupils have access to another device while completing the test. This issue might have long-term ramifications, owing to educational institutions' incapacity to ensure that students have the information required for further levels of education or to accomplish their work. On the other hand, with the incorporation of technology into the curriculum, the teacher's function as an authority figure and mediator is gradually decreasing. It should

be mentioned that the advent of some apps and automation in education has resulted in a decline in the number of instructors in modern schools.

Nevertheless, the surviving educators are burdened with even more obligations compared to previous circumstances, yet their remuneration fails to commensurately reflect the increased responsibilities, resulting in a significant number of them being compelled to relinquish their positions. Once again, while discussing the benefits of technology in the realm of education, it is worth noting that students are afforded the ability to avail themselves of a vast array of material, hence rendering their lessons more captivating. However, it is pertinent to inquire about the temporal investment required for the preparation and integration of this content into a cohesive and relevant framework. The concept of increasing obligations mostly pertains to the many preparations required for academic classes. These preparations are often underestimated by many individuals, largely due to the fact that they are not readily apparent to parents. The issue at hand pertains to the treatment of teachers within educational institutions, which necessitates a resolution. It is imperative that teachers are no longer regarded as mere manual laborers. To initiate progress in this regard, it is crucial to augment their remuneration and afford them the respect they rightfully merit. Failure to do so may result in the presence of disengaged teachers who exhibit apathy towards imparting knowledge to their students. Consequently, this may lead to the emergence of a generation that lacks the capacity to contribute meaningfully to society. Diverse perspectives exist about the implementation of these modifications within the school system, particularly when they are introduced abruptly and within a limited timeframe. However, one should be realistic, because the positives still much exceed the problems. The persistent emphasis on drawbacks should not be interpreted as a longing for a return to conventional education, but rather as a call for prudence and an opportunity to critically examine the limitations

⁹⁷ <https://blog.eera-ecer.de/artificial-intelligence-in-student-assessment/>, accessed on 26 May 2023

⁹⁸ <https://www.slideshare.net/g4li/what-is-stealth-assessment>, accessed on 26 May 2023

⁹⁹ Expanded Learning Time by the Numbers, Center for American Progress, April 2010. Web. <http://www.americanprogress.org/issues/education/news/2010/04/22/7716/expanded-learning-time-by-the-numbers/>, accessed on 29 Jul 2023

¹⁰⁰ Spaulding S, Gordon G, Breazeal C (2016) Affect-aware student models for robot tutors. In: Proceedings of the 2016 international conference on autonomous agents and multiagent systems, accessed on 13 Sep 2023

of educational technology and methodologies. The responsibility for evaluating the drawbacks in subsequent revisions and enhancing the instructional standards within both virtual and traditional educational settings lies on educational establishments and educators.

Benefits and Advantages of Technology Integration in the Education Sphere

Informational resources on the internet make early education far more accessible than in past generations. Because there are so many online resources, they can access research tasks without visiting an actual library.¹⁰¹ The internet is a resource that makes books and high-quality information more accessible. It's not just the act of making and doing but also the sense of independence and power.¹⁰² They have the ability to communicate in ways that words cannot. When children can answer their questions, they are more likely to conduct more research and pursue new lines of reasoning. It helps kids develop independence, academic confidence, and interest in new areas.¹⁰³ Technology develops skill to use modern technology for study for children and student and they use this skill frequently in their daily lives. In 21st century they should learn it at an early age to deal with challenges in education and other areas throughout their lives.¹⁰⁴ It teaches them how to avoid conflicts in school and in their daily lives.¹⁰⁵ It can strengthen their empathy skills and develop other positive attributes.¹⁰⁶ Social media can boost learners' confidence and prepare them for future social marketing opportunities. Kids and children can do many essential things online through social networking platforms. They can stay in touch with friends and family, make new acquaintances, share images, and exchange ideas.¹⁰⁷

One significant advantage of technology in education is that it offers pupils with access to a vast amount of knowledge. They can get to the information as quickly as feasible. Instead of travelling to libraries and searching through stacks of books, a student may now get legitimate material at any time from a wide range of sources to prepare his/her assignment/project/homework, such as websites, Google, instructional sites, YouTube, videos, eBooks, PDFs, and so on.¹⁰⁸ With the

rise of the World Wide Web (www), this is the first time that technology has changed the way students learn. Students can get as much data and information as they want on their computers, tablets, or phones with just a few clicks. This means that any student can plan a lesson or write a paper without help. With this in mind, technology helps students learn more and become smart citizens of the world.¹⁰⁹ Students can access a huge variety of learning materials on the internet. They include scientific articles, journals, research papers, educational videos, tutorials/guidebooks, informational websites, online databases, and blogs of educators/authors.¹¹⁰ Distance learning is a significant advantage of the internet for students. With the power of the internet, online education become a reality. Students can study just as well using a virtual screen or chat room. During the online session, they can share documents, vital resource links, and media assets with other students.¹¹¹

Contemporary students are devoid of any experiential knowledge of a world devoid of sophisticated technological advancements. There was no necessity for them to endure a 45-minute waiting period for the loading of a new webpage, given the sluggishness of the dial-up connection. Educators that adopt technology in their instructional practices enhance their credibility and expertise, hence facilitating the integration of educational applications across many academic disciplines for the present generation.¹¹² Even just a single technological tool can make a major impact on the modern student. It wasn't that long ago when students were forced to drag heavy textbooks to class with them every day. Now most of those textbooks are available online and can be accessed through a computer. Organizational platforms complement the e-books and other tools that are available through technology so that the learning process is streamlined and effective.¹¹³ Technology in the classroom is very vital for instructors. Today, there are engagement technologies that can begin to automate the grading process. Software platforms make it easy to analyze individual student performance and detect learning gaps more quickly. More time for real teaching and less time spent at home evaluating

¹⁰¹ Spitzer M, (2014), Information technology in education: Risks and side effects. Trends in Neuroscience and Education, 3(3-4), 81-85, accessed on 28 Aug 2023

¹⁰² Wallace, K. (2009, June 17), High-Tech Cheating on the Rise at Schools, Cbsnews. Available: <https://www.cbsnews.com/news/high-tech-cheating-on-the-rise-at-schools/>, accessed on 28 Aug 2023

¹⁰³ Roblyer M D, (2003), Integrating Educational Technology into Teaching, (3rd ed). Upper Saddle River, NJ: Merrill Prentice Hall, accessed on 28 Aug 2023

¹⁰⁴ <https://bau.edu/blog/technology-impact-on-learning/>, accessed on 24 Jul 2023

¹⁰⁵ Putnam R, (2000), Bowling Alone: The Collapse and Revival of American Community. New York: Simon and Schuster, accessed on 28 Aug 2023

¹⁰⁶ <https://elearningindustry.com/how-important-is-technology-in-education>, accessed on 24 Jul 2023

¹⁰⁷ Buckleitner Warren, (12 June 2008), "So Young, and So Gadged", The New York Times. Archived from the original on 23 December 2016, accessed on 28 Aug 2023

¹⁰⁸ Holstein, Kenneth; McLaren, Bruce M.; Aleven, Vincent (2018), "Student Learning Benefits of a Mixed-Reality

Teacher Awareness Tool in AI-Enhanced Classrooms", Lecture Notes in Computer Science, Springer International Publishing, ISBN 978-3-319-93842-4, accessed on 25 Aug 2023

¹⁰⁹ Reeves, Thomas C. (12 February 1998), The Impact of Media and Technology in Schools (PDF) (Report). University of Georgia, Archived (PDF) from the original on 20 October 2013, , accessed on 25 Aug 2023

¹¹⁰ Van Leeuwen Anouschka et al, (December 2015), "Teacher regulation of cognitive activities during student collaboration: Effects of learning analytics", Computers & Education, 90: 80–94, accessed on 25 Aug 2023

¹¹¹ Hall, Ashley A.; DuFrene, Debbie D. (June 2016). "Best Practices for Launching a Flipped Classroom", Business and Professional Communication Quarterly. 79 (2): 234–242. doi:10.1177/2329490615606733. ISSN 2329-4906

¹¹² Hall Ashley A, (June 2016). "Best Practices for Launching a Flipped Classroom", Business and Professional Communication Quarterly, 79 (2): 234–242, accessed on 27 Aug 2023

¹¹³ Technology in Schools: Weighing The Pros And Cons". Huffington Post. 25 May 2011. Archived from the original on 23 April 2014, accessed on 27 Aug 2023

work is created by automating more of the tiresome tasks that instructors undertake every day.¹¹⁴ When students of any age are in a learning environment that is based on a lecture format, the amount of information they retain can be as low as 5%. Students who learn in a collaborative environment can retain up to 80% of the information they study.¹¹⁵ And, if interactive practice is included in the classroom environment, information retention levels can reach 95% for some students.

Technology provides various platforms and apps that allow teachers to combine and use all information about their students that may be useful. It can also help teachers' group together students who may benefit more from learning together than learning apart.¹¹⁶ Technology allows students to work at a pace that is comfortable for them. Curriculum demands or programs can be adjusted easier to meet individualized needs to enhance the learning process.¹¹⁷ When technology is used in the classroom, students have more say over how they learn. It gives them a chance to follow their natural curiosity and find out what skills, hobbies, and abilities they have. Technological advances also let students try new things that might not have been possible in the past. For that reason, they can figure out on their own which methods help them learn new things the best.¹¹⁸ Now, students learn how to research new subjects and how to properly source the data they find with the help of technology. These are all vital skills for the modern workplace and today's students have the opportunity to master them before they even start looking for a job.¹¹⁹ When students enter their classrooms each day, they should be able to see the future. Stepping back in time may bring some delight via nostalgia, but it will not prepare pupils for the demands of a techno-

logically based world. We may surely benefit from history's lessons, but we must also be prepared for what the future may contain once the curtain is lifted.¹²⁰

The homework planner or task manager program that teachers use is one of the best things that has come from using technology in the classroom. They can be used instead of a school notebook or paper planner. Teachers can put in all of the days', weeks', or months' worth of work and projects. They can set due dates for them. They are kept up to date in real time as the kids begin, pause, and finish a job.¹²¹ They can also track the individual performance, achievements, and pitfalls of the students. It helps them to decide their syllabi accordingly in the next learning session.¹²² Communication skills are crucial for students to do well in academics and the professional field in the future. It is difficult to make young children sit in one place and learn. They easily get distracted. Similarly, elder students find it tough to keep up their focus and complete large papers or assignments. All in all, education is not a pleasant experience for all students. But, with technology, it is now an enjoyable experience for all.¹²³ The use of tablets, laptops, VR/AR devices, and touch screen boards makes classes exciting for students. Teachers could easily keep up the attention of kids.¹²⁴ Learners in higher grades develop better abilities to communicate with various technological tools and virtual courses. We know that, many students are reluctant to speak with the teachers in class or front of others.¹²⁵ They can interact freely through chat, audio, or video call, during their independent screen time.¹²⁶ It will help student to use their additional knowledge to prepare academic lessons and surpass the scores of others. It also helps aspiring young talents to garner professional skills that will help them in the future to grow.¹²⁷

¹¹⁴Sean, Allan (25 September 2020). "How Covid-19 brought the University of Toronto Class of '24 Together Online". Brooke Godfrey. Archived from the original on 9 August 2021, accessed on 27 Aug 2023

¹¹⁵Kaplan, Andreas (6 April 2021). *Higher Education at the Crossroads of Disruption: the University of the 21st Century*. Emerald Publishing Limited, ISBN 978-1-80071-504-2, Archived from the original on 29 January 2021, accessed on 27 Aug 2023

¹¹⁶Irby Beverly et al, (2013), *Handbook of Educational Theories* Charlotte, NC: IAP. p. 105. ISBN 978-1-61735-866-1, accessed on 27 Aug 2023

¹¹⁷Hergenhahn B R, (2008), *An Introduction to the History of Psychology*. Belmont, CA: Wadsworth Cengage Learning, p. 627, ISBN 978-0-495-50621-8, accessed on 27 Aug 2023

¹¹⁸Termos, Mohamad (2012). "Does the Classroom Performance System (CPS) Increase Students' Chances for Getting a Good Grade in College Core Courses and Increase Retention?", *International Journal of Technologies in Learning*, 19 (1): 45–56. doi:10.18848/2327-0144/cgp/v19i01/49144, accessed on 27 Aug 2023

¹¹⁹Hossain K A (2015) *Leadership qualities for 21st century leaders*, *Journal of Management, Social Science and Humanities*, Published on 19 May 2015, accessed on 27 Aug 2023

¹²⁰Skinner B F, (1954), "The science of learning and the art of teaching", *Harvard Educational Review*, 24: 86–97,

¹²¹Cuban, Larry (2001). *Oversold and Underused: Computers in the Classroom* (PDF), Harvard University Press, Archived

from the original (PDF) on 9 August 2017, accessed on 25 Aug 2023

¹²²Day R et al, (1987), "Computer-managed instruction: an alternative teaching strategy". *Journal of Nursing Education*, 26 (1): 30–6. doi:10.3928/0148-4834-19870101-08, accessed on 25 Aug 2023

¹²³"Baby DVDs, Videos May Hinder, Not Help, Infants' Language Development", University of Washington Press. 7 August 2007. Archived from the original on 15 February 2015, accessed on 25 Aug 2023

¹²⁴D. Randy Garrison; Terry Anderson; *Definitions and Terminology Committee* (2003). *E-Learning in the 21st Century: A Framework for Research and Practice*. Routledge. ISBN 978-0-415-26346-7, accessed on 25 Aug 2023

¹²⁵Moore, J. L. et al, (2011). "E-Learning, online learning, and distance learning environments: Are they the same?", *The Internet and Higher Education*, 14 (2): 129–135. doi:10.1016/j.iheduc.2010.10.001, accessed on 25 Aug 2023

¹²⁶Boser U, (2013), "Are Schools Getting a Big Enough Bang for Their Education Technology Buck?" (PDF), *American Progress*, pp. 1–12. Archived (PDF) from the original on 17 May 2014, accessed on 25 Aug 2023

¹²⁷Tanner Mirrlees; ShahidAlvi (22 October 2019). *EdTech Inc.: Selling, Automating and Globalizing Higher Education in the Digital Age*. New York: Routledge, p. 60, doi:10.4324/9780429343940. ISBN 978-0-429-34394-0, accessed on 25 Aug 2023

The different uses of technology, such as audio-visual presentations, virtual classrooms, wide-screen projectors, and digital planners help teachers to improve their delivery of instructions. This consequently enhanced the understanding and comprehension level of the students.¹²⁸ Besides, technologies increase the productivity of teachers. The digital tools they use not only increase the engagement of students but also provide them with more learning opportunities.¹²⁹ Actually, educational technology helped teachers to increase their productivity, which benefitted both the students and schools.¹³⁰ New tools like digital task planners, virtual classrooms, and eLearning apps are gaining prominence in the market. If they are aware of the trends of EdTech, they can use these tools to their advantage and make progress academically.¹³¹ It improves the physical and mental well-being of students. Various digital tools eased their tedious learning courses and made them interesting. In many ways, EdTech methods improve their cognitive skills.¹³² Virtual learning sessions and the integration of AR are two prime contributors. They enhance the capabilities of their brain to read, interpret, learn, remember, think, and use logic. All these hugely impact their academic learning and performance in the long run.¹³³ As they can score good grades/marks due to the use of educational technology, it gives them confidence and a positive feeling. This boosts their mental health and helps them to concentrate better on their studies.¹³⁴

One of the assured benefits of using technology in education is improved collaboration between students and teachers. Online learning system not just enables the teachers to interact with students during lessons. It also allows the students to engage in one-to-one interactions with the teachers.¹³⁵ By staying at the home, they can upload their projects or homework, which teachers can access and give necessary recommendations.¹³⁶ In the case of collaborative activities like group projects, compare the situation of a classroom with a

virtual classroom setting. There are a few groups of students and the teacher assigns them tasks. Chaos or confusion is inevitable as some students will be loud, some will ask questions, some will be shy to ask, and some could not get the opportunity to be heard.¹³⁷ Contrary to this, such a situation does not happen in an online setting. Every student is connected in the virtual classroom. The teacher responds and resolves queries of each of them individually, on independent screens.¹³⁸ In 21st century, online learning also fostered interactions between students outside the school. They can share ideas and resources for difficult projects and support each other.

Many schools and educators are replacing paper books with eReaders in the wake of rapid environmental damage.¹³⁹ The integration of technology in educational settings has facilitated the comprehension of environmental sustainability among contemporary pupils. The utilization of electronic and digital platforms for educational purposes not only contributes to environmental preservation but also offers enhanced ease for both educators and learners.¹⁴⁰ It assists people in saving money on various learning supplies such as books, notebooks, boards, paper planners, educational trips, and so on. The advantages of employing technology in education now will prepare children and students for a future that will be entirely digital. It also assisted them in establishing priorities for the usage of technology.¹⁴¹ This will help them draw a line and use technology wisely. When students are familiar with different technologies from an early age, they can easily land a job in the desired company.¹⁴² For job training and to teach them how to use computers, software, and online contact tools, their parents don't have to take them anywhere. Normal teaching methods and a competitive classroom are not good for special needs kids or students who aren't doing well in school because they make it hard for them to keep up with the lessons. For them to do better in school, they need extra help.¹⁴³

¹²⁸Harris J et al, (2009), "Teachers' Technological Pedagogical Integration Reframed" (PDF), Journal of Research on Technology in Education, 41 (4): 393–416, accessed on 25 Aug 2023

¹²⁹Geng F, (2014), technologist,...discussed by @A_L_T members". Oxford, UK. Archived from the original on 5 August 2018,

¹³⁰Fletcher S (2013), "Machine Learning", Scientific American, 309 (2): 62–68, accessed on 25 Aug 2023

¹³¹Moret, B. (8 June 2012). "No television for babies: Why TV is bad for young children", The Washington Times. Archived from the original on 4 January 2015, accessed on 25 Aug 2023

¹³²Williamson Ben et al, (2020), "The datafication of teaching in Higher Education: Critical issues and perspectives", Teaching in Higher Education, 25 (4): 351–365, accessed on 25 Aug 2023

¹³³D F O Onah et al, (2014), "Dropout Rates of Massive Open Online Courses: Behavioural Patterns". ResearchGate, accessed on 25 Aug 2023

¹³⁴Herold, Benjamin (5 February 2016). "Technology in Education: An Overview". Education Week. Archived from the original on 1 November 2016, accessed on 25 Aug 2023

¹³⁵Malegam, F (13 December 2022). "How to Empower eLearning with Virtual Classrooms in WordPress?". Adobe, accessed on 25 Aug 2023

¹³⁶Kaplan, Andreas (2017), Rishi, Bikramjit; Bandyopadhyay, Subir (eds.), "Academia Goes Social Media, MOOC, SPOC, SMOC, and SSOC: The digital transformation of Higher Education Institutions and Universities", Contemporary Issues in Social Media Marketing, Routledge, accessed on 25 Aug 2023

¹³⁷rentin G. (2010). Networked Collaborative Learning: Social Interaction and Active Learning Archived 17 September 2018 at the Wayback Machine, Woodhead/Chandos Publishing Limited, Cambridge, UK, ISBN 978-1-84334-501-5, accessed on 25 Aug 2023

¹³⁸"Collaborative asynchronous online learning", US Patent Office, 10 March 2014, Archived from the original on 8 June 2021, accessed on 25 Aug 2023

¹³⁹What is collaborative learning?". spiral.ac. Archived from the original on 3 August 2016, accessed on 26 Aug 2023

¹⁴⁰Nye, D. (2007). Technology Matters: Questions to Live With. Cambridge MA: MIT Press, accessed on 26 Aug 2023

¹⁴¹KimmeHea Amy C, (January 2014), "Social Media in Technical Communication", Technical Communication Quarterly, 23 (1): 1–5, accessed on 26 Aug 2023

¹⁴²Suppes, P. (19 May 1971). Computer Assisted Instruction at Stanford (PDF) (Report). Archived from the original (PDF) on 17 July 2010, accessed on 26 Aug 2023

¹⁴³Vie Stephanie, (3 July 2017), "Training Online Technical Communication Educators to Teach with Social Media: Best

There are digital apps that allow teachers to set individualized learning programs and schedules for them. It also assisted teachers to teach students with ADHD (Attention-deficit/hyperactivity disorder) or such issues, independently.¹⁴⁴

Now, with the digital transformation and the rise of educational technology, teachers have begun making drastic changes to their instruction, assessments, even the physical make-up of their classrooms, and at a much faster rate than expected.¹⁴⁵ These current trends are making headlines in education because of the ways in which they are impacting student learning.¹⁴⁶ Again, modern classrooms are outfitted all over the country with iPads and laptops for each student.¹⁴⁷ Google Chromebooks account for over half of the devices in US classrooms. In 2014, more than three million Chromebooks were used in educational institutions.¹⁴⁸ And that number is growing continuously. Virtual reality has the capability of bringing the outside world into the classroom and vice versa.¹⁴⁹ Apps such as Unimersiv can transport students to ancient Greece, while Cospaces allows students to share their virtual creations with the world.¹⁵⁰ According to Kathy Schrock, an online adjunct professor at Wilkes University and an independent educational technologist, virtual reality has the capacity to enhance visual literacy, technical literacy, and audience engagement. The concept of integrating Augmented Reality, Virtual Reality, and Mixed Reality (AR/VR/MR) is eagerly awaited in academic circles. Consider, as an illustration, the privately held enterprise Magic Leap.¹⁵¹ Even though it has yet to really sell anything, Magic Leap is already valued at four and a half billion dollars! This speaks to the projected endless possibilities of technology transforming classrooms.¹⁵²

21st century classrooms are SMARTboards instead of chalkboards and pods of SMARTdesks instead of individual seating.¹⁵³ In this day and age, students

don't just read books; they go on virtual field trips and make media instead of just looking at it. Colleges and universities are making learning places on campus less rigid because they know how important it is to create and work together all the time, not just during class. Even though it's not new, IoT has to be at the top of our list because technology has come so far. In the past, when educators talked about IoT, they mostly talked about things like making schools and colleges more energy efficient. Once teachers have this important data, they can tell if their lessons are helping students, if the homework is too hard, or if students are staying up late to finish it.¹⁵⁴ This is a valuable insight as it would enhance future digital transformation trends in education. Also, it can help students gain momentum for homework time at home.¹⁵⁵ The use of AI in higher education has already proven useful. Australia's Deakin University used IBM Watson to create a virtual student advisory service that was available 24-hours a day, seven days a week.¹⁵⁶ Use for AI includes chatbots, Siri, personalizing learning, evaluating the quality of curriculum and content, and facilitating one-on-one tutoring with the use of Intelligent Tutoring Systems. Actually, technology doesn't aim to replace teachers, only to complement them.¹⁵⁷ Adaptive learning technology collects information about student behavior as they're answering questions, and then subsequently uses that information to provide instant feedback in order to adjust the learning experience accordingly.¹⁵⁸ In adaptive learning where students make critical decisions such as the task to be completed in the timeframe and the path chosen.¹⁵⁹ Adaptive learning involves collecting data about students' behavior as they counter and overcome problems and later provide feedback.¹⁶⁰

Benefits of Integrating Technology in the Classroom

The integration of technology into education not only offers many advantages to eLearning, but also

Practices and Professional Recommendations". Technical Communication Quarterly, 26 (3): 344–359, accessed on 26 Aug 2023

¹⁴⁴ <https://www.tryclarifi.com/adhd-student-planner/>, accessed on 26 Aug 2023

¹⁴⁵ <https://www.brookings.edu/articles/promises-and-pitfalls-of-online-education/>, accessed on 26 Aug 2023

¹⁴⁶ <https://www.forbes.com/sites/danielnewman/2017/07/18/top-6-digital-transformation-trends-in-education/?sh=37ae58902a9a>, accessed on 26 Aug 2023

¹⁴⁷ Hickey Ryan, (12 May 2014), "The history of online education", Peterson's, Archived from the original on 19 March 2018, accessed on 26 Aug 2023

¹⁴⁸ <https://www.cnbc.com/2015/12/03/googles-chromebooks-make-up-half-of-us-classroom-devices.html>, accessed on 26 Aug 2023

¹⁴⁹ <https://www.eschoolnews.com/featured/2017/01/02/hot-edtech-trends-2017/>, accessed on 26 Aug 2023

¹⁵⁰ <https://www.thetechedvocate.org/20-top-virtual-reality-apps-that-are-changing-education/>, accessed on 26 Aug 2023

¹⁵¹ Hiltz S, (1990), "Evaluating the Virtual Classroom". In Harasim, L. (ed.) Online Education: Perspectives on a New Environment. New York: Praeger, pp. 133–169, accessed on 26 Aug 2023

¹⁵² <https://campustechnology.com/Articles/2017/01/18/11-Ed-Tech-Trends-to-Watch-in-2017.aspx?Page=1>, accessed on 26 Aug 2023

¹⁵³ <https://www.benq.com/en-in/business/resource/trends/steps-and-checklists-to-build-a-blended-learning-classroom.html>, accessed on 26 Aug 2023

¹⁵⁴ <https://elearningindustry.com/digital-trends-in-2019-shape-education-5>, accessed on 26 Aug 2023

¹⁵⁵ Hossain, K. A., Evaluation of Influence of Internet of Things (IoT) Technologies and Devices in 21 Century, Scientific Research Journal 11 (7), Jul 2023, accessed on 26 Aug 2023

¹⁵⁶ <https://campustechnology.com/Articles/2017/01/18/11-Ed-Tech-Trends-to-Watch-in-2017.aspx?Page=2>, accessed on 27 Aug 2023

¹⁵⁷ Hossain K. A., Evaluation of Influence of Artificial Intelligence (AI) on Technologies in 21st Century, Journal of Electronics and Communication Engineering Research, Quest Journal, Jul 2023, accessed on 27 Aug 2023

¹⁵⁸ <https://onlinedegrees.sandiego.edu/what-is-educational-technology-definition-examples-impact/><https://www.adaptemy.com/>, accessed on 27 Aug 2023

¹⁵⁹ Harasim, L., Hiltz, S., Teles, L. and Turoff, M. (1995), Learning Networks: A Field Guide to Teaching and Learning Online. Cambridge, MA: MIT Press, accessed on 27 Aug 2023

¹⁶⁰ McCue, T. J. (27 August 2014). "Online Learning Industry Poised for \$107 Billion in 2015". Forbes. Archived from the original on 25 August 2017, accessed on 26 Aug 2023

adds a twist to the eLearning definition.¹⁶¹ The profession of teaching encompasses a multifaceted role that entails the undertaking of several labor-intensive responsibilities. The utilization of tools that enhance the retention of fundamental information enables educators to allocate their time and resources towards providing individualized support to pupils requiring specialized interventions. Each additional minute dedicated to instruction has a discernible impact throughout the duration of the academic year. There are several discernible benefits associated with the incorporation of technology into the educational setting, which are delineated below.

➤ **Technology in the classroom does have a cost, but it is a minimal one.** For less than the price of a set of textbooks, students can be given a Google Chromebook instead and access all of their books from it.¹⁶² Students could have access to the computer in the classroom – if not take it home every day as well.¹⁶³

➤ **Students can study at their convenient time and from anywhere from the world. It makes education versatile.**¹⁶⁴ For example, a person who is working can decide to take a course online and not worry about time to attend classes.¹⁶⁵ They just have to figure out how to balance work with school.¹⁶⁶

➤ **Technology in the classroom can boost learning motivation.** Most kids and students enjoy using technology in some way.¹⁶⁷ It allows active learners to remain engaged with the lessons and encourages not-so-active learners to find something that they might classify as fun.¹⁶⁸ One of the best advantages that technology provides to the classroom is an increased level of motivation.

➤ **Students, business people and IT specialists can get their desired certificates online.** For example, a person seeking a real estate license can go online and take courses to get real estate license.¹⁶⁹

➤ **Today, use of technology in education enhances competencies beyond knowledge and skills.** It results in improved understanding of concepts that are complex and will lead to connecting ideas, processes, and learning strategies in students and even teachers regarding problem-solving.¹⁷⁰

➤ **Integration of technology in education and the classroom makes learning enjoyable and interesting.** It can even be used for remote learning opportunities if the stimulus of a classroom is too much for the student.¹⁷¹

➤ **It makes teaching easy.** Teachers may attend and take class from his suitable places. It also helps them to prepare class more effectively and professionally.¹⁷²

➤ **It offers a wider choice of materials that can be accessed easily.** The vast array of educational technology that is available today offers students a wide range of options from which they can choose the best ones for their learning needs.¹⁷³ This helps them develop the right kind of skills and knowledge so that they can become good professionals in their chosen field.

➤ **It helps to improve learners' communication skills and performance in school and workplace settings.** Students and earners who are able to communicate better through technological means will also perform better academically as well as in work settings because communication skills are very important when you want to get your point across effectively.

➤ **It provides fun and engaging learning experience for students.** Today's learners are not only required to learn but they also need to have fun while doing so.¹⁷⁴ Educational technology offers students the opportunity to have fun while learning, which will also help them stay motivated and excited about their studies.

➤ **It allows learners to access the internet from anywhere at any Time.** The internet has become such an integral part of our lives that we hardly find people

¹⁶¹ <https://elearningindustry.com/4-tips-to-create-a-work-school-balance-while-taking-online-courses>

¹⁶² <https://www.globalsources.com/manufacturers/dell-chromebook-3100-2-in-1-11.6-inch-touch.html?>, accessed on 27 Aug 2023

¹⁶³ Strauss, Valerie (22 September 2012). "Three fears about blended learning", The Washington Post., Archived from the original on 16 July 2017, accessed on 28 Aug 2023

¹⁶⁴ Beatty, Ian D; Gerace, William J (January 2009). "Technology-Enhanced Formative Assessment: A Research-Based Pedagogy for Teaching Science with Classroom Response Technology". *Journal of Science and Technology*, 18 (2): 146, accessed on 25 Aug 2023

¹⁶⁵ Baker, Celia (4 January 2013). "Blended learning: Teachers plus computers equal success". *Desert News*, Archived from the original on 23 October 2013. Retrieved 30 January 2014, accessed on 27 Aug 2023

¹⁶⁶ Spector Jonathan Michael, (16 October 2014), "Conceptualizing the emerging field of smart learning environments", *Smart Learning Environments*. 1 (1), doi:10.1186/s40561-014-0002-7, accessed on 26 Aug 2023

¹⁶⁷ Sendall P et al, (December 2008), "Web 2.0 Matters: An Analysis of Implementing Web 2.0 in the Classroom", *Information Systems Education Journal*, 6 (64). Archived from the original on 29 November 2014, accessed on 26 Aug 2023

¹⁶⁸ Rosenberg Richard, (2004), *The Social Impact of Computers*. Amsterdam: Elsevier Academic Press. ISBN 978-0-12-597121-8, accessed on 27 Aug 2023

¹⁶⁹ <https://www.usnews.com/higher-education/online-education/articles/2017-05-03/study-online-learning-enrollment-rising-fastest-at-private-nonprofit-schools>, accessed on 27 Aug 2023

¹⁷⁰ <http://virtuallyinspired.org/portfolio/osmosis/>, accessed on 27 Aug 2023

¹⁷¹ Hossain K. A., Analysis of development trend of ship designing software and future of ship design, *American Journal of Engineering Research (AJER)*, Vol 12, Issue 6, June 2023, ISSN 2120-0847

Hossain K. A., Tale of Container Ship, *Journal of Software Engineering and Simulation*, Quest Journals 9 (7), page: 48-61, Jul 2023, accessed on 27 Aug 2023

¹⁷² Andone Diana, (26 November 2014), 2014 International Conference on Web and Open Access to Learning (ICWOAL), pp. 1–4. doi:10.1109/ICWOAL.2014.7009244. ISBN 978-1-4799-5739-2, accessed on 26 Aug 2023

¹⁷³ "Student Self-Assessment", unsw, Archived from the original on 13 August 2016, accessed on 26 Aug 2023

¹⁷⁴ Al-Asfour A, (2012), "Online Teaching: Navigating Its Advantages, Disadvantages and Best Practices". *Tribal College Journal of American Indian Higher Education*, 23: 3, accessed on 26 Aug 2023

who do not use it on a daily basis. In today's world, it is essential for students to be able to access the internet from anywhere at any time so that they can do their assignments and research without having to travel all over a place or wait for a particular time when they can do so.¹⁷⁵ Using educational technology helps learners in this regard because it allows them to connect with the internet even when they are in a classroom, school, or at home.

➤ It helps learners learn new skills and acquire new knowledge. Learning new skills and acquiring new knowledge are two very important aspects of life that learners should be able to enjoy. Through the use of educational technology, learners can acquire these skills and also develop their knowledge through various programs that are available online. These programs offer students the opportunity to learn about various topics that are interesting and useful for their respective fields of work or studies.¹⁷⁶ It helps students and learners stay up to date and well informed with new technological advancements.

➤ It allows students to improve themselves both mentally and physically. The benefits of using educational technology also include the improvement of learners' mental and physical health.¹⁷⁷ By using these tools, students are able to enhance their learning and their cognitive skills, which in turn help them, improve their academic performance as well as their physical health.¹⁷⁸

➤ Playing and learning collide when classrooms utilize gaming as an instructional tool. Gaming technology makes learning difficult subject matter more exciting and interactive.¹⁷⁹ Today, virtual game worlds provide a unique opportunity to apply new knowledge and make mission-critical decisions, while identifying obstacles, considering multiple perspectives and rehearsing various responses.¹⁸⁰

➤ Now, teachers can tutor the students from distance or communicate easily outside the classroom. This enhances their ability to give instructions, improve the learning of students, and help them get better academic scores.¹⁸¹ Moreover, technology integration in education resulted in mobile/desktop applications that are helpful as digital attention coaches for students.

They helped teachers to organize the homework or tasks of students. They can easily know whose grades are lower or who is slow in completing lessons. They can provide the necessary guidelines to them and help to gradually improve their academic performance.¹⁸²

Limitations and Challenges of Technology in Education

The modern classroom has taken several steps forward in its evolution of the learning environment in the past 25 years. Many of the benefits that we have seen in this setting are due to the introduction of new technology options for students. Instead of having a single computer for a class to use or a laboratory environment for the entire school placed in one room, we can now help students learn at their table or desk with items issued to them directly.¹⁸³ Our development of the Internet since 1989 has helped us to include more technological access to information in the modern classroom as well. If you grew up as an 80's kid, then you had the A/V cart come into your class to watch educational videos and maybe have a snack. Now students get to play interactive learning games, compete against other students, and have their educational statistics tracked in real-time data to know where their point of focus should be. Introducing technology to students in a classroom setting can certainly help the educational environment, but it also requires equal access for all students to ensure that everyone receives the same opportunities to success. That is why each school district, teacher, and parent should periodically review the advantages and disadvantages of technology in education settings.¹⁸⁴

A built-in study found that over 90% of teachers believed that technology helped them reinforce courses and favorably improve student performance. Other research found that after embracing technology and digital tools, the majority of middle-school children increased their test scores or grades. Despite this optimistic situation, the employment of technology in education is fraught with difficulties. Excessive screen time caused by educational technology can have a detrimental impact on pupils' attentiveness. There are also concerns about instructors' ability to use tools or technology ideas such as AR, VR, and AI. Because of a

¹⁷⁵Gail S Thomas, (1 February 1988), "Connected Education, Inc", Netweaver, Electronic Networking Association. Archived from the original on 27 August 2008, accessed on 26 Aug 2023

¹⁷⁶ Molenda, M. (2008), "Historical foundations", In M. J. Spector, M. D. Merrill, J. Merrienboer, & M. P. Driscoll (Eds.), *Handbook of Research on Educational Communications and Technology* (Third., pp. 3–20). New York, NY: Lawrence Earlbaum Associates, accessed on 26 Aug 2023

¹⁷⁷Bates A, (2005), *Technology, e-Learning and Distance Education*, London: Routledge, accessed on 27 Aug 2023

¹⁷⁸Hwang, G. J. (2014), Definition, framework, and research issues of smart learning environments-a context-aware ubiquitous learning perspective, *Smart Learning Environments*, 1(1), 1-14, accessed on 25 Aug 2023

¹⁷⁹Craft, Anna (July 2012), "Childhood in a digital age: creative challenges for educational futures" (PDF), *London Review of Education*, 10 (2): 173–190. doi:10.1080/14748460.2012.691282, accessed on 27 Aug 2023

¹⁸⁰ <https://campustechnology.com/Articles/2017/01/18/11-Ed-Tech-Trends-to-Watch-in-2017.aspx?Page=3>, accessed on 27 Aug 2023

¹⁸¹J. Bransford; A. Brown; R. R. Cocking, eds. (2000), "Technology to support learning". *How people learn: Brain, mind, experience*. Washington, DC: National Academies Press. pp. 206–230, accessed on 25 Aug 2023

¹⁸²"Global E-Learning Market 2017 to Boom \$275.10 Billion Value by 2022 at a CAGR of 7.5% – Orbis Research", Archived from the original on 27 May 2018, accessed on 25 Aug 2023

¹⁸³Algerioy A. M., (1999), The impact of multimedia on the collection of first-grade students in secondary mathematics in *Riyadh Journal of King Saud University - Languages and Translation*, 24 (2), 75-82, accessed on 28 Aug 2023

¹⁸⁴ <https://futureofworking.com/10-advantages-and-disadvantages-of-technology-in-education/>, accessed on 28 Aug 2023

shortage of resources, many schools were unable to afford the technology. Teachers and students face a number of hurdles in order to succeed in the face of educational technology. If sufficient security measures are not implemented, computers can give young children with access to inappropriate content or information. Website blocks, internet filters, and constant supervision can assist to protect youngsters from such exposure, and courses in 'netiquette,' or correct internet use, can implant good web judgment and habits in children at a young age. According to studies, more people are getting detached and isolated as a result of the connections that technology gives through social networks. Young children who spend more time interacting with electronics may spend less time socializing with their classmates, which can have an impact on their social and emotional development. To mitigate this danger, it is critical to limit 'technology time' so that children may connect socially with family and friends. Many technology-based games and activities are 'pre-made,' allowing youngsters to perform tasks without needing to solve problems in novel and inventive ways. There are, however, just as many games that encourage creative growth and problem-solving abilities while still functioning as an enjoyable solitary or group activity. Choosing the latter, as well as giving a wide range of additional learning materials, such as manipulatives or painting supplies, will guarantee that your children benefit from their play time in a safe and productive manner.¹⁸⁵

Even though there are many good things about educational technology, the bad things should also be thought about. You can see that computers have some limits: they can't solve all of our problems. People can think in a lot of different ways, while computers can't do some things, like brainstorm or come up with new ideas. The knowledge on the internet is not always correct or useful, which is another problem with using technology in schooling. Online, there are lots of ways for people to lie about what they've done and what they know about something to get credit for things they didn't do or know nothing about. Before you use something, you find on the internet, you should always get it checked out. Also, students who take classes online are known to get sidetracked by their phones or other electronics when they need to focus on their work or studies. They might lose attention and not do their work right because of this. Some people might not want to take classes online because they don't feel like they are really learning. This is the last problem with technology in education. Some people like going to class in person because they can see their peers' faces and get to know them better. They can also see how much everyone else knows about a subject. There are, however, many types of online courses that you can use if you want to take

classes online. These include mobile learning, live virtual classrooms, online videoconferencing, and more. We've talked about the problems and restrictions of using technology in school below. Here is a summary of the challenges that they mostly face while adopting educational technology.

According to a recent study, it was observed that educators who possess tablet-based gadgets in their classrooms are prone to encountering distractions during instructional sessions. The presence of technology in the classroom led to a lack of focus among students, resulting in their disengagement from the subject matter. According to experts, it is advisable to reduce the utilization of technology inside educational settings due to its potential to serve as a source of distraction, hence leading to more disruptions.¹⁸⁶ Students are sure to get distracted by things like laptops and tablets in the classroom. This is especially true if the software doesn't block access to apps that have nothing to do with lessons, quizzes, and other educational activities.¹⁸⁷ There must be a mechanism to control the usage of electronics in schools so that they are utilized to assist pupils learn rather than to play games or use social media for entertainment. Concerningly, high school pupils may be more knowledgeable about technology than their professors. Students can access sites that aren't permitted by navigating to a proxy site that provides material from other sites without actually visiting those sites. Although the pace with which technology advances may appear to be an obvious benefit, experienced instructors are wary of it. Devices and programs that assist you in learning can learn quicker than the human mind. Students may gloss over details, missing out on texture and depth. Thinking clearly and logically takes time. Students who utilize technology have less need to communicate with their professors and with one another. With online teaching and learning, there is no face-to-face interaction. To address this, teachers should ensure that oral presentations, recitations, and group work occur often in the classroom. We must remember that our purpose is to assist them in becoming well-rounded adults.¹⁸⁸ For teens and young adults who spend too much time on games or social media, school could be a break. Teachers are the ones who need to notice when students have their screens out for too long. Kids should be pushed or encouraged to connect with each other when they're not on technology.¹⁸⁹ Advances in technology allow students to learn at their own pace, and on their own time. But it may not be a

¹⁸⁵ <https://elearningindustry.com/the-limitations-of-educational-technology>, accessed on 28 Aug 2023

¹⁸⁶ Reeves, Thomas C. (12 February 1998), *The Impact of Media and Technology in Schools* (PDF) (Report). University of Georgia, Archived (PDF) from the original on 20 October 2013, accessed on 28 Aug 2023

¹⁸⁷ Ascione, L. (2018). Do other countries value classroom technology equally? Available:

<https://www.eschoolnews.com/2018/12/04/do-other-countries-value-classroom-technology-equally/> (July 2, 2019), accessed on 28 Aug 2023

¹⁸⁸ Bahloul M, (2012), *Lights! Camera! Action and the Brain: The Use of Film in Education*. Newcastle upon Tyne: Cambridge Scholars Publishing, accessed on 28 Aug 2023

¹⁸⁹ Carter S P. et al, (2017). Should Professors Ban Laptops? *EducationNext*, 17(4), 68-74, accessed on 28 Aug 2023

good thing when personal relationships are lost in the process.¹⁹⁰

Students may believe that technology may help teachers save time on their to-do lists, but this is not always the case. Technology evolves at such a rapid pace that it may give both instructors and students difficulties. Teachers frequently need to acquire new topics while they are being evaluated by academics. To make problems worse, upgrades and adjustments are constant.¹⁹¹ Experts say we should spend time on the things that are important, not spending time on technology that isn't. You might think that technology is the answer to better education, but it doesn't have to be. Teachers will always be necessary in order to guide and mentor students.¹⁹² The best technology is one that lets students talk to and meet with teachers in person. There is a lot of information on the internet these days, but not all of it is correct. It's not always safe to believe what you read online, even if it comes from a strong source. Websites care more about how they rank these days than about what information they give visitors. To get more people to visit their sites, many of them post fake information, even if it's not true.¹⁹³ Now in TV shows and movies where kids would break into a teacher's classroom, steal the answer key to a test, and then write down everything on their wrist, shoe, or a slip of paper? Now a student can send themselves a text with that information.¹⁹⁴ They may disseminate such information to anybody with a phone. Email can also be used to send this information. In addition, strong restrictions must be in place regarding the usage of technology during quizzes or examinations when an accurate evaluation of student understanding is required to evaluate their overall development.¹⁹⁵ Eye pain does happen when we stare at a computer screen for too long. Back pain, eye pain, neck pain, tiredness, fuzzy vision, and trouble focusing are all signs of this problem. A condition called early myopia can happen to more than 60% of people older than 12 who use computers a lot and for

long periods of time. For some people, this health problem gets worse over time. This means that the time they spend on their phone, computer, or TV can also cause eye health problems.¹⁹⁶

Today, there is a lot of material on the Internet that is false or exaggerated in some way, yet it appears to be true. According to New York Magazine study, less than 60% of online traffic now is through human-based searches or content engagement. Bots that pose as individuals account for up to half of all YouTube traffic each year. Not only is the information occasionally fraudulent, but the users may also be phony.¹⁹⁷ Whether technology is in the classroom or at home, there is the issue of affordability to worry about in today's world. Some households cannot afford to purchase computers for their kids to manage their school work.¹⁹⁸ Students with greater access can learn more and have access to lessons more often, which means they have additional information exposure that can increase their opportunities to succeed.¹⁹⁹ Interactive learning lessons are so effective today that the software or app can become the teacher instead of having someone present to help a student. Instead of being in a hands-on role, technology makes the teacher more of an observer.²⁰⁰ New technology simplifies the process of learning and changes to meet the needs of each student. Every year, more than 15 million people have their identities stolen in some way. Over US\$ 16 billion is lost every year because of this evil business. Because of this problem, over US\$ 100 billion has been lost since 2011. More people can use technology these days, which is one reason why it's becoming more common. Whenever we bring technology into the classroom, we put our kids' identities at risk every day.²⁰¹ Even though applications, laptops, mobile devices, and operating systems have powerful privacy filters that lower the danger of identity theft, there is no way to ensure that all threats are eliminated unless the equipment is never connected to the internet. If we go this route, we will lose many of the benefits of having technology in the classroom in the first place.²⁰²

¹⁹⁰Carstens A, et al, (2005), Get ready for the Gamer Generation. Tech Trends: Linking Research & Practice to Improve Learning, 49(3), 22-25,

¹⁹¹Biocchi Michael, "Games in the Classroom", Gaming in the Classroom, Archived from the original on 15 August 2011, accessed on 28 Aug 2023

¹⁹²Al-Asfour, A (2012), "Online Teaching: Navigating Its Advantages, Disadvantages and Best Practices", Tribal College Journal of American Indian Higher Education. 23: 3, accessed on 28 Aug 2023

¹⁹³Cazan A et al, (2016), Computer anxiety and attitudes towards the computer and the internet with Romanian high-school and university students. Computers in Human Behavior, 55, 258-267, accessed on 28 Aug 2023

¹⁹⁴Trentin G. (2010). Networked Collaborative Learning: Social Interaction and Active Learning Archived 17 September 2018 at the Wayback Machine, Woodhead/Chandos Publishing Limited, Cambridge, UK, ISBN 978-1-84334-501-5, accessed on 28 Aug 2023

¹⁹⁵Croft N. et al, (2010). Overcoming isolation in distance learning: Building a learning community through time and space. Journal for Education in the Built Environment, 5(1), 27-64, accessed on 28 Aug 2023

¹⁹⁶Eyyam R et al, (2014), Impact of use of technology in mathematics lessons on student achievement and attitudes.

Social Behavior and Personality: An International Journal, 42(1), 31S-42S, accessed on 28 Aug 2023

¹⁹⁷Dansieh S. A., (2011), SMS Texting and Its Potential Impacts on Students' Written Communication Skills. International Journal of English Linguistics, 1(2), 222-229, accessed on 28 Aug 2023

¹⁹⁸Denoël, E. et al, (2017), Drivers of Student Performance: Insights from Europe. McKinsey & Company, accessed on 28 Aug 2023

¹⁹⁹Redecker Christine, (2009), "Review of Learning 2.0 Practices: Study on the Impact of Web 2.0 Innovations on Education and Training in Europe". JRC Scientific and Technical Reports (EUR 23664 EN – 2009), Archived from the original on 7 December 2016, accessed on 28 Aug 2023

²⁰⁰El-Hussein M et al, (2010), Defining mobile learning in the higher education landscape. Educational Technology & Society, 13(3), 12-21, accessed on 28 Aug 2023

²⁰¹Epper R et al, (2001), Teaching Faculty How to Use Technology. USA: American Council on Education. Oryx Press, accessed on 28 Aug 2023

²⁰²Seely Brown et al, (2008), "Minds on Fire: Open Education, the Long Tail, and Learning 2.0" (PDF). Educause Review (January/February 2008): 16–32. Archived from the original (PDF) on 16 July 2014, accessed on 28 Aug 2023

Even though applications, laptops, mobile devices, and operating systems have powerful privacy filters that lower the danger of identity theft, there is no way to ensure that all threats are eliminated unless the equipment is never connected to the internet. If we go this route, we will lose many of the benefits of having technology in the classroom in the first place.²⁰³ Only clear boundaries and expectations to follow can counter this issue so that technology can provide a needed learning opportunity.²⁰⁴ Technology makes it easy for people to talk to each other, which is a good thing. It's easier to cheat because it's so easy to talk to people. This is especially true if the teacher isn't watching what the students do on the computer. All it takes is one group email to send out the answers to a quiz or test. One easy way to deal with this problem is to give students tasks that need their own unique point of view.²⁰⁵ Encouragement of thought rather than memory generally lessens the desire to cheat. One in every five children in the United States (US) lives in a family where there is no regular food security. The incorporation of contemporary technologies into their life comes second. It's preferable to have a pantry full of vital goods than a new iPhone in your pocket. To be a successful learning tool, schools must give equitable access to technology to all students. Barriers to free resources, such as computer access at a library, must be removed. This problem can only be solved through sharing.²⁰⁶ There is a lot of good stuff that can be found on the internet today. There is also a lot of misleading and outright false data that can be found as well.²⁰⁷ Students must learn how to identify a quality information source from something that might be labeled as 'fake news.' Drawing opinions on questionable content could put students at a disadvantage when it comes time to carve out a spot for them with the rest of society.²⁰⁸ Even though firewalls and site blockers can keep kids from seeing most of the harmful content online, some parents go even further and only let their kids do simple research and word processing on the computer. Students

are given homework at home that tells them to use technology on their own, at the library, or through a loan program. This is done so that parents don't have to do it.²⁰⁹ If we force limits on children instead of teaching them how to make wise choices, then is that really giving them a learning environment?²¹⁰

Many software learning tools like apps provide teaching mechanisms within the program itself. With a program like ABC Mouse, students can interact with a programmed online teacher as they complete learning lessons. That forces the teacher into a role of observer or manager.²¹¹ Teachers may never become obsolete, but technology in the classroom can replace much of what they have done in the past already.²¹² That implies that rather than building a tailored curriculum to apply, the future of education may lay in being active in the development of new technologies. Not everyone understands how to use the current technologies that help instructors stay organized. Learning how to utilize a new tool can be just as difficult as completing a difficult program to acquire a teaching degree or certification in the first place.²¹³ Some school systems might not even help pay for these tools, but they still expect to see them in the classroom. In other words, the teacher doesn't get paid extra for these things. Having a conversation with someone online is very different from having a conversation with them in person. Once someone thinks they can be private, they start to lose control over what they say and do. For the ease of a screen, words, and images, some people even stop talking to other people in real life.²¹⁴ That is why technology should be used as a tool in the classroom. It cannot be the only component of the learning process for students.²¹⁵ If student cannot recall a piece of information instantly, then what is their next step to find an answer? Most people would say that they would look online for the data they want or ask a

²⁰³Granata K, (2019), Tech May Be to Blame for Decline in Students' Reading for Pleasure: Education World. Available: https://www.educationworld.com/a_news/technology-proves-negatively-effect-reading-skills,

²⁰⁴Vie, Stephanie (3 July 2017), "Training Online Technical Communication Educators to Teach with Social Media: Best Practices and Professional Recommendations", *Technical Communication Quarterly*, 26 (3): 344–359. doi:10.1080/10572252.2017.1339487. ISSN 1057-2252, accessed on 28 Aug 2023

²⁰⁵Johnson M et al, (1999), Technology as a change agent for the teaching process. *Theory into Practice*, 38(1), 24-30, accessed on 29 Aug 2023

²⁰⁶LeBlanc A G et al, (2015), Correlates of Total Sedentary Time and Screen Time in 9–11 Year-Old Children around the World: The International Study of Childhood Obesity, Lifestyle and the Environment, *PLoS ONE*, 10 (6), accessed on 29 Aug 2023

²⁰⁷Šad S et al, (2014), Preservice teachers' perceptions about using mobile phones and laptops in education as mobile learning tools, *British Journal of Educational Technology*, 45(4), 606-618, accessed on 29 Aug 2023

²⁰⁸Kaplan, Andreas (6 April 2021). *Higher Education at the Crossroads of Disruption: the University of the 21st Century*. ISBN 978-1-80071-504-2, accessed on 29 Aug 2023

²⁰⁹Fried, C. B., (2008), In-class laptop use and its effects on student learning, *Computers & Education*, 50(3), 906- 914, accessed on 28 Aug 2023

²¹⁰Verzosa Hurley et al, (January 2014), "The Rhetoric of Reach: Preparing Students for Technical Communication in the Age of Social Media", *Technical Communication Quarterly*, 23 (1): 55–68, accessed on 28 Aug 2023

²¹¹Nneji B. U. et al, (2014), Technologies in education and the dehumanization and imperialization of pedagogy: The African perspective. *Bulgarian Journal of Science and Education Policy*, 8(1), 86-105, accessed on 29 Aug 2023

²¹²<https://www.dejaoffice.com/blog/2020/10/28/7-disadvantages-of-technology-in-education/>, accessed on 29 Aug 2023

²¹³Lowerison G et al, (2006). Student perceived effectiveness of computer technology use in post-secondary classrooms. *Computers & Education*, 47(4), 465-489, accessed on 29 Aug 2023

²¹⁴<https://www.smartprix.com/bytes/a-guide-to-emojis-types-of-emojis-what-do-they-mean-how-to-use-them/>, accessed on 29 Aug 2023

²¹⁵Haßler B et al, (2015). Tablet use in schools: A critical review of the evidence for learning outcomes. *Journal of Computer Assisted Learning*, 32(2), 139-156, accessed on 29 Aug 2023

virtual assistant, like Alexa, to give them the answer.²¹⁶ It is good to have access to a treasure mine of resources, but their existence may also foster reliance. If we do not educate children how to retain information without the help of a smart device or computer, the future generation of pupils may be unable to function unless they have access to technology.²¹⁷ Encouraging the use of tech might help to create more learning opportunities, but it can also lead to a lifestyle that is more sedentary.²¹⁸ When children sit for too long during the day, then they face the same health challenges that adults do when not getting enough exercise. There can be problems with obesity, hyperactivity, muscle fatigue, sleeping problems, and metabolism issues with prolonged sitting.²¹⁹ That's why any school that brings technology into the classroom should also try to get students to do some mild physical exercise every day.

Theft of identities is a big problem these days. In the United States in 2016, about US\$ 16 billion was stolen from 15.4 million people. Javelin Strategy and Research says that between 2011 and 2016, identity thieves took more than US\$ 107 billion from people. Every day, students' privacy is at risk when they use high-tech tools.²²⁰ There are risks in this area that can't be fully eliminated, even though most apps and software have strict privacy settings. When you watch something on a computer screen, a smartphone screen, or a tablet screen, it can hurt your eyes. Some of the signs that this is happening are eye discomfort, tiredness, and even blurred vision. CBS News reports that kids who use computers a lot are more likely to develop nearsightedness early in life. Now, nearly 60% of kids aged 12 and up have myopia.²²¹ Children are uniquely adaptable to changing environments. What they see is what they think is normal, even if what they see is problematic. That includes more than just their eyesight.²²² Children often lose track of time when they are using a device with a screen. This leads to prolonged periods of sitting, which could lead to hyperactivity, obesity, and other issues.²²³ Moreover, it has the potential to disrupt the child's sleep habits by causing a detachment from

their inherent circadian cycle. Once again, the integration of technology inside educational settings is frequently constrained to fulfilling word processing requirements or facilitating rudimentary research tasks. The diverse applications of contemporary technology are frequently subject to restrictions or limited access, mostly due to political or individual motivations. The constraints imposed on technology usage have a detrimental impact on its efficacy and result in unfavorable modifications to pupils' learning prospects.²²⁴ Technology can provide access to a vast amount of data, but it can also create a personal dependence upon that access.²²⁵ Students using technology every day might feel offended by the idea of picking up a real book to read. They might even resist going outside for recess or to participate in family activities.²²⁶

Technology Can Help Student in Many Ways Technology helps students access to information and resources.

Technology provides students with instant access to a vast amount of information and resources. The internet and digital tools allow students to explore various subjects, conduct research, and access educational materials that may not be available in traditional textbooks.²²⁷ In real life, there are many ways that students can use technology to help them learn. Online databases and digital libraries give students access to a wide range of academic and study materials that can help them learn. These include e-books, educational papers, journals, and multimedia content. Learning management systems (LMS) and educational tools make it easy for teachers to share materials and give students access to information. Digital textbooks, multimedia material, engaging lessons, and homework can all be stored on these sites. Open Educational Resources, or OER, are 21st century educational tools that can be found online for free. Open Educational Resources (OER) sites let teachers find textbooks, lesson plans, videos, and other materials that fit with the lessons and give students extra sources of knowledge. Everyone knows that when students do research projects, they have to go to the library to get a few books to read, a thesaurus, and even microfilm to

²¹⁶KimmeHea et al, (January 2014), "Social Media in Technical Communication", Technical Communication Quarterly, 23 (1): 1–

5. doi:10.1080/10572252.2014.850841, ISSN 1057-2252, S2CID 219641115, accessed on 28 Aug 2023

²¹⁷Bowdon, Melody A. (1 January 2014), "Tweeting an Ethos: Emergency Messaging, Social Media, and Teaching Technical Communication", Technical Communication Quarterly, 23 (1): 35–54. doi:10.1080/10572252.2014.850853. ISSN 1057-2252, accessed on 28 Aug 2023

²¹⁸Flanagan J. L. et al, (2008), Technology: The Positive and Negative Effects on Student Achievement. NY: University of New York, accessed on 28 Aug 2023

²¹⁹Friess Erin et al, (October 2018), "Cultivating a Sense of Belonging: Using Twitter to Establish a Community in an Introductory Technical Communication Classroom", Technical Communication Quarterly. 27 (4): 343–361, accessed on 28 Aug 2023

²²⁰Baker, Celia (4 January 2013). "Blended learning: Teachers plus computers equal success", Desert News, Archived from the original on 23 October 2013, accessed on 29 Aug 2023

²²¹Nye D. E. et al, (2006), Technology Matters: Questions to Live with, The MIT Press, accessed on 29 Aug 2023

²²²Purcell K et al, (2013), The Impact of Digital Tools on Student Writing and How Writing is taught in Schools: Pew Research Center. Available: <https://www.pewinternet.org/2013/07/16/theimpact-of-digital-tools-on-student-writing-and-how-writing-is-taught>, accessed on 29 Aug 2023

²²³Unesco (5 March 2020). "Distance learning solutions". Archived from the original on 31 March 2020, accessed on 29 Aug 2023

²²⁴Technology in Schools: Weighing The Pros And Cons". Huffington Post. 25 May 2011. Archived from the original on 23 April 2014, accessed on 29 Aug 2023

²²⁵Rosenberg, Richard (2004), The Social Impact of Computers. Amsterdam: Elsevier Academic Press. p. 219, ISBN 978-0-12-597121-8, accessed on 29 Aug 2023

²²⁶As Schools Close Over Coronavirus, Protect Kids' Privacy in Online Learning", Human Rights Watch. 27 March 2020. Archived from the original on 10 April 2020, accessed on 29 Aug 2023

²²⁷<https://explorance.com/blog/7-reasons-students-need-technology-classroom/#>, accessed on 24 Feb 2023

look at. This gives them all the tools they need to finish their work.

Technology connects the classroom experience to the real world.

Technology allows educators to remove the physical barriers of the classroom, offering students a way to connect the curriculum with the real world and those areas of academic focus that can genuinely enrich the student experience.²²⁸ A geology professor, for example, conducts her pupils on a virtual tour of the Grand Canyon National Park. A history instructor takes his students on a tour of the White House's halls and history. Virtual guest speaker sessions may also be facilitated by technology, allowing students to engage with experts and professionals from many sectors via video conferencing, increasing their access to knowledge and real-world viewpoints. Students utilize technology in all parts of their life outside of the classroom. Technology in the classroom may make learning more enjoyable and fascinating. Here are some creative ideas for incorporating technology into classroom activities. In the twenty-first century, technology enables students to use educational gaming websites or apps that provide interactive quizzes, puzzles, and challenges relevant to the subject matter. This keeps pupils entertained and competitive while reinforcing their learning.²²⁹

Technology can prepare students for the modern workplace. Students need more than just a basic understanding of today's technology in order to do well in the workplace of the 21st century. Students need to learn how to use the tools and skills they will probably find in the modern workplace. Schools make sure their students are ready for the job market in more than one way by using these tools in routine lessons and activities.²³⁰ Digital literacy skills are in high demand in the workplace.²³¹ Students learn to navigate digital platforms, use productivity tools, interact online, and effectively communicate through digital mediums by incorporating technology into the classroom. Students may use technology to obtain, organize, and analyze vast volumes of data. Employees are frequently required to collect data and do research in order to make educated judgments. Students become acquainted with infor-

mation management tools and processes in the classroom, preparing them for these jobs. Students are exposed to a variety of digital tools and platforms through technology integration. This experience helps students become adaptive and versatile in their use of various technologies, as employers in the twenty-first century frequently ask employees to learn and adapt to new technologies and applications.

Technology encourages collaboration, communication, creativity and Innovation. Technology can help students make multimedia slideshows, plan projects, build prototypes, and come up with new ways to say what they think. In many fields, where creative problem-solving and new ideas are needed, these skills are highly valued. A lot of teaching tools have different features that make it easier for people to work together. Users of videoconferencing apps like Zoom, Microsoft Teams, Slack, and Skype can hold virtual talks with friends from anywhere in the world. Students can quickly share and update projects with each other using free online storage services like Google Drive. This makes it easier for people to work together in both

school and the workplace. This mirrors the teamwork and communication skills required in any workplace in 21st century.

Technology allows global awareness and cultural exchange. Technology allows students to connect with peers and experts from around the world. Through video conferencing, online collaborations, and virtual exchange programs, students can gain global awareness, learn about different cultures, and develop a broader perspective on various issues. No two kids learn in the same manner, but with the correct tools, instructors may accommodate differences in learning styles and experiences. In the twenty-first century, a Student Insight Solution platform such as Explorance Blue can assist in identifying student requirements based on real-time input. Explorance Blue promotes student learning by enabling teachers to interact and engage with every student, regardless of where they are, what they do, their culture/beliefs, or their obstacles.

²²⁸Kemp Nenagh et al, (1 January 2014), "Face-to-face or face-to-screen?, Undergraduates' opinions and test performance in classroom vs. online learning", *Frontiers in Psychology*, 5: 1278, accessed on 30 Aug 2023

²²⁹Clark, R C et al, (2007), *eLearning and the Science of Instruction*, San Francisco: Pfeiffer. ISBN 978-0787986834, accessed on 30 Aug 2023

²³⁰Kronholz J., (2011), "Getting at-risk teens to graduation", *Education Next*, Vol. 11, no. 4, accessed on 30 Aug 2023

²³¹Richards J. C. et al, (2010). *Longman Dictionary of Language Teaching and Applied Linguistics* (4th ed). London: Pearson, accessed on 30 Aug 2023



Figure 9: Advantage of technology in education²³² and technology benefits learning²³³

Technology teaches students to become digital citizen. There are so many social networking sites that most kids are already digital citizens. But kids can learn how to be responsible in the digital world and with their digital activities if technology is used in the classroom. Students can practice talking to, finding, and interacting with other digital citizens in class, which becomes a small version of the larger digital world.²³⁴ It enables students to collect student input, conduct class surveys, and stimulate class discussions by utilizing online polling tools or survey platforms. This promotes active involvement and allows pupils to express themselves. It also assists students in the introduction of coding and programming activities through the use of instructional coding platforms or applications.²³⁵ Students can learn the basics of coding through game-based tutorials and then apply their skills to create simple programs or animations in 21st century.

Technology helps students to become smart citizen. Effective teachers use technology to improve their lessons and get their students more involved. However, it's important to make sure that kids know how to search for information, evaluate sources seriously, and use technology safely. Teachers are very important for helping kids learn how to use technology and find knowledge.²³⁶ It assists students in becoming focused and learning smart technologies such as Artificial Intelligence (AI), Machine Learning (ML), Big Data, Reality (AR), Virtual Reality (VR), and so on. Students may now experiment with AI, machine learning, augmented reality, and virtual reality technologies to create immersive and interactive learning experiences. AR/VR tools may be used by students to tour historical locations, dissect virtual creatures, and visualize complicated topics

in three dimensions. In the twenty-first century, students may utilize AI/ML technologies or applications to learn and gain knowledge from anywhere in the globe.

Technology can create problem for student in many ways deterioration of students' competencies in reading, writing and arithmetic. Those are the three basic skills any student is expected to master.²³⁷ In general, technology in the classroom helps students do better in school and motivates them to finish their work. A lot of time spent on technology seems to make it harder for kids to do three skills that are clearly important to them: reading, writing, and math.²³⁸ Students do not learn as much from Google Books as they do from traditional books and periodicals. Similarly, criticizes technology of making our thoughts "shallow" and claims that kids who read linear texts have higher comprehension and recall than those who read over the Internet. The transition from paper to screen alters more than simply how we read a piece of text.²³⁹ It also influences the degree of attention we devote to it and the depth of our immersion in it. When we go online, we enter an environment that promotes cursory reading, hurried and distracted thinking, and superficial learning.²⁴⁰ Classroom technologies drastically affect students' ability to write, notably when it comes to spelling and punctuation, grammatical accuracy, spelling, proofreading, critical thinking, respect of coherence and linearity. Constant exposure to short forms cripples' students' ability to splash out effort in writing and that the short forms that are frequently used in texting makes it daunting for them to distinguish formal

²³² <https://topadvantagesof.com/11-advantages-of-digital-technology-in-education/>, accessed on 01 Aug 2023

²³³ <https://elearningindustry.com/technology-benefits-learning>, accessed on 01 Aug 2023

²³⁴ Deschaine Mark et al, (2017), "Increasing Student Engagement in Online Educational Leadership Courses" (PDF). Journal of Educators Online: 6. Archived (PDF) from the original on 31 December 2018, accessed on 31 Aug 2023

²³⁵ Izadpanah, S., (2016), The perception of EFL high school students in using of computer technology in the process of learning: Merits and demerits. Advances in Language and Literary Studies, 7(3), 146- 156, accessed on 31 Aug 2023

²³⁶ Su Jiahong et al, (24 May 2023), "Teaching artificial intelligence in K–12 classrooms: a scoping review". Interactive Learning Environments: 1–20, accessed on 31 Aug 2023

²³⁷ Bishop J., (2013), The flipped classroom: A survey of the research. 120th ASEE National Conference Proceedings, 30, pp. 1-8. Atlanta, GA, accessed on 31 Aug 2023

²³⁸ Al-Hariri M, (2017), Impact of students' use of technology on their learning achievements in physiology courses at the University of Dammam, Journal of Taibah University Medical Sciences, 12(1), 82-85, accessed on 31 Aug 2023

²³⁹ Clarke B., (2014), An updated literature review on the use of tablets in education. Tablets for Schools, UK: Family Kids & Youth, accessed on 31 Aug 2023

²⁴⁰ Carr, N. (2011). The Shallows: What the Internet Is Doing to Our Brains. New York: W. W. Norton & Company, accessed on 31 Aug 2023

conventions of writing from informal ones.²⁴¹ When it comes to the fields of mathematics and arithmetic, the utilization of technology in educational instruction presents a plethora of possible problems that may be considered embarrassing. Calculators often include a numerical orientation, which may hinder pupils from developing a robust mental comprehension. It is likely that their perspective on mathematics will exhibit a greater emphasis on procedural aspects, thereby leading to potential limitations in their problem-solving abilities. The utilization of technological instruments in the 21st century may impede the formation of individuals' structural perspective on mathematics. Furthermore, due to its nature, a calculator has the potential to provide inaccurate data and generate cognitive dissonance when it comes to understanding mathematical language.²⁴² In 2012, the UK government announced its intention to ban calculators in primary schools because students use them too much.²⁴³

Dehumanization of education. In many contexts, technology dehumanizes education and distorts the interaction between teachers and pupils. Teachers give their lectures from a distance in higher education institutions and online courses, for example, and students are obliged to engage with robots rather than humans. As a result, the instructor knows nothing or very little about his or her pupils, and the students have no intimate contact with their teacher. Technology is now drawing students away from their actual surroundings. They truly tune out the rest of the world. College students are now accustomed to a world of electronic footprints left by online blogging, instant messaging, and Web surfing.²⁴⁴ Dependence on technology in the classrooms also entails the lack of rapport between teachers and students and/or among students themselves; which leads to eroding the social relationships involved in teaching, thereby eroding one of the main aims of education.²⁴⁵ If teachers depend on technology for a long time in the classrooms, there is hardly any time for them to have any impact on their students in 21st century. In

the same fashion, students do not have the opportunity to develop sound relationships with one another.²⁴⁶

Isolation of students in a digital and virtual world. Technology makes it harder for students to connect with others in any way. Psychoanalytic Theory says that people isolate themselves as a way to protect themselves when they are in a situation that they find scary or unpleasant. Because of this, students who use technology a lot start to feel safe and secure when they are "wired" to their devices and avoid all social ties that could get them separated. Paul and Brier came up with the word "friend sickness" in 2001 to describe how lonely college students feel when they leave their old school friends behind.²⁴⁷ They pretend that technology bridges that gap in relationships and provides those young students with the impression that those friendships have not faded away.²⁴⁸ Drawing attention to the risk of technology-enhanced isolation and the harmful effects it may have on children's social development, the author says, "The fact that a computer is usually placed in a person's room instead of a family room and that a child uses it alone, without any other family members being there, raises concerns about social isolation and their negative effects on their social development." Turkle (2011) highlights the dichotomous effect of technology when it divides its users between the illusory illusion of companionship on the one hand and the terrifying reality of solitude on the other. "We easily find 'company' online, but are exhausted by the pressure of performance," she says.²⁴⁹ We enjoy continual connection but rarely have each other's attention." This feeling of isolation often results in a feeling of loneliness and is greatly related to the dehumanizing effect of technology. In 2013, Karsenti and Fievez evoke the case of Quebec children being distracted due to the excessive reliance on tablets in learning in 21st century.²⁵⁰ The repetitive use of technology-based games and entertainment, in a bid to render the lessons more appealing, entails students' isolation, and could finally lead to poorer outcomes of learning.²⁵¹ Distraction can also be added to the technical problems accompanying the use

²⁴¹Bronowicki, K. A. (2014). Technology's adverse effects on students' writing: An emphasis on formal writing is needed in an academic curriculum. Master's Thesis: State University of New York, accessed on 31 Aug 2023 Available:https://digitalcommons.brockport.edu/cgi/viewcontent.cgi?referer=https://www.google.com.eg/&httpsredir=1&article=1399&context=ehd_theses, accessed on 31 Aug 2023

²⁴²Zheng T., (1998), Impacts of using calculators in learning mathematics, The 3rd Asian Technology Conference on Mathematics (ATCM'98), 1-10. Available: <http://www.any2any.org/EP/1998/ATCMP015/paper.pdf>, accessed on 31 Aug 2023

²⁴³ Stacey, O. (2014, November). Subtracting calculators from maths tests doesn't add up. Available: <https://thenferblog.org/2014/11/12/subtracting-calculators-from-maths-tests-doesnt-add-up/>, accessed on 31 Aug 2023

²⁴⁴ Spitzer M., (2014), Information technology in education: Risks and side effects. Trends in Neuroscience and Education, 3(3-4), 81-85, accessed on 31 Aug 2023

²⁴⁵Nneji, B. U. (2014). Technologies in education and the dehumanization and imperialization of pedagogy: The African perspective. Bulgarian Journal of Science and Education Policy, 8(1), 86-105, accessed on 31 Aug 2023

²⁴⁶ Nicholas, C., et al, (2010), Overcoming isolation in distance learning: Building a learning community through time and space. Journal for Education in the Built Environment, 5(1), 27-64, accessed on 31 Aug 2023

²⁴⁷ Paul, E. et al, (2001), Friendsickness in the Transition to College: Precollege Predictors and College Adjustment Correlates. Journal of Counseling and Development, 79(1), 77-89, accessed on 31 Aug 2023

²⁴⁸ Lee S. J. (2009). Online Communication and Adolescent social Ties: Who Benefits more from Internet Use? Journal of Computer-Mediated Communication, 14(3), 509-531, accessed on 31 Aug 2023

²⁴⁹Turkle S., (2011), Alone Together: Why we Expect more from Technology and less from Each Other. New York: Basic Books, accessed on 31 Aug 2023

²⁵⁰Karsenti, T., &Fievez, A. (2013), TheiPad in education: Uses, benefits and challenges. A survey of 6,057 students and 302 teachers in Quebec, Canada, Montreal: CRIFPE, accessed on 31 Aug 2023

²⁵¹Iserbyt, P. C. (2014). Learning basic life support (BLS) with tablet PCs in reciprocal learning at school: Are videos superior to pictures? A randomized controlled trial, Resuscitation, 85, 809-813, accessed on 31 Aug 2023

of tablets by young students, even in the case of completing simple tasks such as gap filling and matching, especially if there is no technical support available to deal with those problems in a prompt way.²⁵²

Technology creates and deepening social inequalities. The gap between students who can afford technology and those who can't is growing between those who do and those who don't. There is a big gap between the rich and the poor because of technology. The infrastructure of schools in wealthy and emerging countries is very different from one another. Most schools in developed countries have computers, laptops, tablets, projectors, and Internet connection. Most schools in poor countries, on the other hand, don't have any of these things.²⁵³ Thus, students in developing countries graduate with limited basic technological skills like PC literacy and face huge problems to find a well-paid job, or find it too difficult to compete in the global market. Even in developed countries, there is usually a digital divide as there is a big difference between students coming from different social backgrounds.²⁵⁴ Poor children may have access to technology in the classroom but cannot buy any device at home, as seen by their academic success when compared to their wealthy friends. According to a National Telecommunications and Information Administration (NTIA) assessment, city dwellers in the United States are 50% more likely to have Internet connection than those living in rural regions.²⁵⁵ A comment by Sarah Phinney, the distance learning coordinator at Porterville Adult School in Central California, shows the results of this digital divide as follows: In my seven years' experience working with this population [at Porterville Adult School], I have found that a great number of the students we serve, especially those who speak English as a second language, are computer illiterate and thus are on the lean side of the divide.²⁵⁶ If this is the result of the digital divide in the US, it must be much worse and bigger in other countries where the divide is bigger, like in LDCs (less developed countries) where private schools and universities have better access to working technology than public schools and universities. This is shown by the fact that graduates

from these two types of schools have very different levels of knowledge in the 21st century.²⁵⁷

Emotional and behavioral issues. Children may have an overwhelming desire to emulate their heroes or peers. When they can't meet up or do what they observe on TV, it can cause worry or a sense of inadequacy and inferiority.²⁵⁸ FOMO (Fear of Missing Out) emerges, a toxic combination of worry and inadequacy. The online world can be a breeding ground for hate. The internet provides an opportunity for children to be emotionally plagued in 21st century.²⁵⁹ Children and teenagers can use technology and social media to bully other kids without even meeting them. This behavior is commonly referred to as cyberbullying in 21st century.²⁶⁰ It is common even with younger students.²⁶¹

²⁵²Culén A, et al, (2012), Tweens with the iPad classroom – Cool but not really helpful, International Conference on e-learning and e-technologies in education (ICEEE), (pp. 1-6). Technical University of Lodz, Poland, accessed on 31 Aug 2023

²⁵³Kemp Nenagh et al, (1 January 2014), Face-to-face or face-to-screen?, Undergraduates' opinions and test performance in classroom vs. online learning", *Frontiers in Psychology*, 5: 1278. doi:10.3389/fpsyg.2014.01278, accessed on 31 Aug 2023

²⁵⁴Van Dijk, J, (2011), The digital divide as a complex and dynamic phenomenon, *The Information Society: An International Journal*, 19(4), 315-326, accessed on 31 Aug 2023

²⁵⁵Steele-Carlin S., (June 2017), Caught in the digital divide, *Education World*, Available: http://www.education-world.com/a_tech/tech041.shtml, accessed on 31 Aug 2023

²⁵⁶Tapscott D. (1999), *Growing up Digital: the Rise of the Net Generation*. New York: McGraw-Hill,

²⁵⁷Warschauer M., (2011), Dissecting the "digital divide": A case study in Egypt. *The Information Society: An International Journal*, 297-304, accessed on 31 Aug 2023

²⁵⁸Wallace, K. (2009, June 17), High-Tech Cheating on the Rise at Schools, *Cbsnews*. Available: <https://www.cbsnews.com/news/high-tech-cheating-on-the-rise-at-schools/>, accessed on 31 Aug 2023

²⁵⁹Rideout, V.; Vanderwater, E.; Wartella, E. (2003), *Zero to six: Electronic media in the lives of infants, toddlers, and preschoolers (Report)*, Menlo Park, California: The Henry J. Kaiser Family Foundation. Archived from the original on 24 December 2014, accessed on 31 Aug 2023

²⁶⁰Kester, Liesbeth; Kirschner, Paul; Corbalan, Gemma (May 2007), "Designing support to facilitate learning in powerful electronic learning environments", *Computers in Human Behavior*, 23 (3): 1047–1054, accessed on 31 Aug 2023

²⁶¹Craft Anna, (July 2012), "Childhood in a digital age: creative challenges for educational futures" (PDF). *London Review of Education*, 10 (2): 173–190, accessed on 31 Aug 2023

Reduced sleep quality. Because of portable devices like smart-phones and tablets, children now have access to media content at any time of day. It implies that people may spend the entire night reacting to texts and messages instead of sleeping.²⁶² Sleep is necessary for physical and mental health, and children need a lot of sleep.²⁶³ A good night's sleep aids development, improves heart health, influences weight, boosts attention span, and even aids in study. Misuse and a lack of understanding of how much technology is 'too much' are two of technology's disadvantages. Ensure that anybody supervises and limits their children's use of technology in the twenty-first century.²⁶⁴



Figure 10: Disadvantage of technology in education and technology become addiction

Reduced physical activity. When kids use technology too much, it can cause health problems that can have very bad effects. People who spend more time on their phones, playing computer games, or watching TV are less likely to be busy generally. A lifestyle that is less healthy is encouraged by more people using technology.²⁶⁵ It may lead to several health issues, including obesity, coronary heart disease, and diabetes type 2. Children who spend more time on a screen spend less time outside or partaking in physical activities.²⁶⁶ They may also engage in more mindless eating when watching TV or playing video games.²⁶⁷ That is why it is necessary to understand some strategies to get kids to eat without gadgets. Pediatricians or registered dietitians can offer guidance on healthy eating habits and physical activity, monitor growth and development, while parents can promote a healthier lifestyle by encouraging outdoor activities, limiting screen time, and providing healthy snacks.²⁶⁸ Taking proactive steps to manage

obesity can help children achieve optimal health and avoid long-term health issues in 21st century.²⁶⁹

²⁶²Vonberg J., (2015, December 8), The loneliness of the long distance learner, The Guardian, Available: <https://www.theguardian.com/higher-education-network/2015/dec/08/you-work-in-a-vacuum-the-loneliness-of-the-long-distance-learner>, accessed on 31 Aug 2023

²⁶³Cuesta Cambra et al, (1 July 2017), "The Cognitive Processing of an Educational App with EEG and 'Eye Tracking'", Comunicar, 25 (52): 41–50. doi:10.3916/c52-2017-04, accessed on 03 Sep 2023

²⁶⁴"Guiding Principles for Use of Technology with Early Learners", Office of Educational Technology, Archived from the original on 6 November 2018, accessed on 03 Sep 2023

²⁶⁵Biocchi Michael, "Games in the Classroom", Gaming in the Classroom. Archived from the original on 15 August 2011, accessed on 03 Sep 2023

²⁶⁶Schindler, Laura A.; Burkholder, Gary J.; Morad, Osama A.; Marsh, Craig (December 2017). "Computer-based technology and student engagement: a critical review of the literature", International Journal of Educational Technology in Higher Education, 14 (1): 25. doi:10.1186/s41239-017-0063-0. ISSN 2365-9440, accessed on 03 Sep 2023

²⁶⁷"Technology in the Preschool Classroom", study.com, Archived from the original on 6 November 2018, accessed on 03 Sep 2023

²⁶⁸Publications, "The Rise of Cyber-Schools", The New Atlantis, Archived from the original on 25 February 2013

²⁶⁹Viorica-Torii, C., & Carmen, A. (2013), The impact of educational technology on the learning styles of students. Procedia-Social and Behavioral Sciences, 83, 851-855, accessed on 03 Sep 2023

Weakened social skills. Children of the new generation play online games, access websites and communicate on Facebook. Continuous use of technological devices can restrict the development of basic interaction skills.²⁷⁰ Social skills know when to take turns in discussions, reading and using facial expressions, and making good eye contact. It's not that spending time online is awful. But too much time online can sever the bond between parents and children and inhibit kids' development of social skills.²⁷¹ So, technology can positively benefit children along with too much exposure can have harmful consequences in 21st century. These are less likely to occur if student minimize their screen time. Stick to their pediatrician's advice and their best judgment of a balanced day for child. Supervise their social time, screen time, and physical activity. The key to parenting is balance, moderation, and supervision.²⁷²

New experiences can feel and seem scary.

Because the brain prefers what it is acquainted with, we frequently feel at ease in familiar settings. So, it's no surprise that technology may be blamed for many of the problems we face as a society. We are frequently cautious or terrified of technology since it moves so quickly and may seem so strange owing to the pace of advancement and invention. It is natural to be afraid of the unknown and uncomfortable with new things, yet technology facilitates new experiences.²⁷³ For as long as there has been technology, there have been those warning against it. From radios and TVs to the internet and social media, technology has forced us to adapt to new and unknown worlds.²⁷⁴ How much time do student spend in front of screens each day? The average screen time, by age, can be surprising for most people. People spend numerous hours each day in front of smart-phones, laptops, tablets and other devices for school, work, and recreation.²⁷⁵ Most people feel some guilt about the amount of time they spend looking at screens throughout the day.²⁷⁶

Some Suggested and Recommendation

Today, technology is used in a lot of different ways in schools. All over the world, modern technology has grown very quickly, which has had a big impact on how students learn and how teachers teach. A school's level of success is often judged by how much technology it uses in the classrooms.²⁷⁷ As a result, technology has had a significant impact on students' social and educational life, which naturally generates concerns about the repercussions of its usage. According to the Association for Educational Communications and Technology (AECT), educational technology is the research and ethical practice of enhancing learning and increasing performance via the development, use, and management of suitable technological processes and resources. So, the definition of technology includes not just 'TECHNOLOGY' such as the internet or computer, but also the application of scientific knowledge to improve learning.²⁷⁸ Actually, no one contests that removing technology from the classroom is practically impossible in 21st century.²⁷⁹ Yet limiting its negative effects is still at our reach. UNICEF (2017) advises technology users to 'Harness the good.' and 'limit the harm.'²⁸⁰ A list of suggestion/recommendations on how to handle technology in a way that would not be threatening to students in 21st century has been given below.²⁸¹

➤ Making sure learners to interact with each other even when immersed in their digital world.²⁸² We should include visualization tools in student tracking technologies which allow teachers to easily interpret student progress.

➤ Technology should be used as to facilitate Teaching and Learning. Devising activities which necessarily promote communication and collaboration.²⁸³

➤ Sharing and comparing (blog posts, classroom projects, etc) to see how technology can connect learners all around the world.²⁸⁴

²⁷⁰ Steele-Carlin S, (2017, June), Caught in the digital divide, Education World, Available: http://www.education-world.com/a_tech/tech041.shtml, accessed on 03 Sep 2023

²⁷¹ Stacey, O. (2014, November). Subtracting calculators from maths tests doesn't add up. Available: <https://thenferblog.org/2014/11/12/subtracting-calculators-from-maths-tests-doesnt-add-up/>, accessed on 03 Sep 2023

²⁷² <https://www.cyberwise.org/post/positive-and-negative-effects-of-technology-on-children>, accessed on 26 Aug 2023

²⁷³ "Technology in Schools: The Ongoing Challenge of Access Adequacy and Equity" (PDF), NEA Education Policy and Practice Department, Archived from the original (PDF) on 25 October 2019, accessed on 03 Sep 2023

²⁷⁴ <https://www.cyberwise.org/post/from-social-media-to-smartphones-how-technology-affects-our-mental-health>, accessed on 31 Aug 2023

²⁷⁵ Kronholz, J., (2011), "Getting at-risk teens to graduation", Education Next, Vol. 11, no. 4, ProQuest 1237831598,

²⁷⁶ <https://www.igi-global.com/article/learning-object-models-learning-service/1666>, accessed on 03 Sep 2023

²⁷⁷ Stacey, O. (2014, November). Subtracting calculators from maths tests doesn't add up. Available: <https://thenferblog.org/2014/11/12/subtracting-calculators-from-maths-tests-doesnt-add-up/>, accessed on 03 Sep 2023

²⁷⁸ https://www.researchgate.net/post/Confusion_over_the_Concept_of_Educational_Technology, accessed on 11 Sep 2023

²⁷⁹ Shiao, Dennis. "Why Virtual Classrooms Are Excellent Learning Venues", INXPO, Archived from the original on 5 November 2013, accessed on 03 Sep 2023

²⁸⁰ UNICEF Report (2017). The State of the World's Children 2017: Children in a Digital World. Available: https://www.unicef.org/publications/files/SOWC_2017_ENG_WEB.pdf (June 14, 2019), accessed on 03 Sep 2023

²⁸¹ Wilkins, K. (2014, May). How New Technologies Affect Student-Teacher Relationships. British Council Voices Magazine, Available: <https://www.britishcouncil.org/voices-magazine/new-technologies-affect-studentteacher-relationships>, accessed on 03 Sep 2023

²⁸² Wentworth D. et al, (2014), Technology use and academic performance, Computers & Education, 78, 306-311, accessed on 03 Sep 2023

²⁸³ Warschauer M., (2011), Dissecting the "digital divide": A case study in Egypt. The Information Society: An International Journal, 297-304, accessed on 03 Sep 2023

²⁸⁴ Serbyt, P. C., (2014), Learning basic life support (BLS) with tablet PCs in reciprocal learning at school: Are videos superior to pictures? A randomized controlled trial, Resuscitation, 85, 809-813, accessed on 03 Sep 2023

➤ Encouraging tech-savvy students to design interactive content that would enrich the course.²⁸⁵ There should be professional development efforts toward those which emphasize the use of technology in instruction, rather than for administrative tasks.

➤ Provide teacher training by highlighting constructivism and student-centered education. Involve teachers in the decision-making process when adopting new technologies in education is essential.²⁸⁶

➤ Teacher training may also be another springboard whereon to stand when seeking to guarantee the appropriate use of technology.²⁸⁷ In fact, the more training teachers receive, the better way technology would be used and the less negative effects it would entail.²⁸⁸

➤ Technology-based devices would not be effective unless their use is accompanied by appropriate pedagogical approaches.²⁸⁹

➤ Surprisingly inserting technology in teaching will not have the expected added value unless objectives are clearly set and tasks are well-designed.²⁹⁰ In 21st century, teachers generally appreciate the benefits of educational technologies, they often find smooth and effective integration of new educational technologies challenging. From acquisition of new technology equipment to adaptation of curricula and teaching techniques to incorporate new educational tools, technology integration presents significant challenges to educators at each level of school systems.²⁹¹

➤ Technology is perhaps the strongest factor shaping the educational landscape in 21st century. We should use appropriate technology for teaching and learning process, educational administration, educational management, educational evaluation, etc.²⁹²

➤ Educational systems are now required to ensure that integrating ICT programs in the curriculum

should be supported by effective Continuing Professional Development (CPD) programs for instructors wherein technology-based learning is incorporated. Parents should also be made aware that technology is not a blessing all the time, and that it is now their own priority to harness that strong drive among their offsprings to use technology everywhere and at any time.²⁹³

➤ Actually, computer was not developed for the management, it was developed for the calculation and simulation and today we see that it is used in every aspect. So, our mind set and attitude to use and take help from technology will make us beneficial.²⁹⁴

➤ Technological pedagogical knowledge (TPK) requires more than knowing useful pedagogical or academic techniques and familiarity with technologies; it requires an understanding of how particular technologies can provide support for particular pedagogical strategies or techniques. Technological pedagogical content knowledge (TPACK) additionally requires an understanding of how technologies can support pedagogies for specific domains.²⁹⁵

➤ Research on the brain has shown that the simple act of writing by hand has slowing and stimulating effects that help people learn and remember things. Typing is fast, but it is boring because each keystroke is almost the same.²⁹⁶ Writing by hand is harder more complicated, and takes more time. This makes it easier for learner brain to form more 'hooks' to hold on to ideas.²⁹⁷

➤ Students can also get around a school firewall by using a virtual private network (VPN) to encrypt their browsing data so that their activities on the internet can't be tracked.²⁹⁸

²⁸⁵ Bishop J. et al, (2013), The flipped classroom: A survey of the research. 120th ASEE National Conference Proceedings, 30, pp. 1-8. Atlanta, GA, accessed on 03 Sep 2023

²⁸⁶ Hu Het al, (2014), iPads for STEM teachers: A case study on perceived usefulness, perceived proficiency, intention to adopt, and integration in K-12 instruction. *Journal of Educational Technology Development and Exchange*, 7, 49-66, accessed on 10 Sep 2023

²⁸⁷ Tremblay, Eric (2010), "Educating the Mobile Generation – using personal cell phones as audience response systems in post-secondary science teaching", *Journal of Computers in Mathematics and Science Teaching*, 29 (2): 217–227, Archived from the original on 31 October 2010, accessed on 04 Sep 2023

²⁸⁸ Cleaver S, (2014), Technology in the Classroom: Helpful or Harmful? Retrieved from <http://www.education.com/magazine/article/effective-technology-teaching-child/>, accessed on 11 Sep 2023

²⁸⁹ Laurillard, D. (2002). *Rethinking University Teaching: A Conversational Framework for the Effective Use of Educational Technology* (2nd ed.), London: Routledge, accessed on 03 Sep 2023

²⁹⁰ McFarlane, A. (1997). *What Are We and How Did We Get Here? Information Technology and Authentic Learning: Realizing the Potential of Computers in the Primary Classroom*. London: Routledge, accessed on 03 Sep 2023

²⁹¹ Hofer M et al, (2012), TPACK development in teacher education: A longitudinal study of preservice teachers in a secondary M.A.Ed. program. *Journal of Research on Technology in Education*, 45, 83–106, accessed on 11 Sep 2023

²⁹² U. S. Department of Education, Office of Educational Technology, (2010), *Transforming American education: Learning powered by technology*, National Educational Technology Plan 2010, Retrieved March, 20, 2015, from <http://nces.ed.gov/pubs2007/2007020.pdf>, accessed on 11 Sep 2023

²⁹³ Turkle S, (2011), *Alone Together: Why we expect more from Technology and less from Each Other*. New York: Basic Books, accessed on 03 Sep 2023

²⁹⁴ Althoff T et al, (2015). Donor retention in online crowdfunding communities: A case study of DonorsChoose.org. *Proceedings of the 24th International Conference on World Wide Web*, 34-44, accessed on 11 Sep 2023

²⁹⁵ Brantley-Dias L, (2013), Goldilocks and TPACK: Is the Construct "Just Right?" *Journal of Research on Technology in Education*, 46, 103–128, accessed on 11 Sep 2023

²⁹⁶ Alhusban A. M., (2016), The Impact of Modern Technological Tools on Students' Writing Skills in English as a Second Language, *US-China Education Review*, 6 (7), 438-443, accessed on 28 Aug 2023

²⁹⁷ <https://topadvantagesof.com/disadvantages-of-technology-in-education/>, accessed on 28 Aug 2023

²⁹⁸ Kaplan, Andreas (2017). Rishi, Bikramjit; Bandyopadhyay, Subir (eds.), "Academia Goes Social Media, MOOC, SPOC, SMOC, and SSOC: The digital transformation of Higher Education Institutions and Universities", *Contemporary Issues in Social Media Marketing*. Routledge, doi:10.4324/9781315563312-2, accessed on 28 Aug 2023

➤ If the educational environment uses reward-based games to encourage learning, then the child might be more concerned with what they receive through the software or app instead of what they are learning. Although correct answers can be an indication of knowledge, there might not be as much information retention as hoped.²⁹⁹

➤ Teachers must set and enforce healthy boundaries when using technology in the classroom to ensure healthy results are possible.³⁰⁰

➤ Learning how to work with one another using technology is an essential skill, but it cannot be the other option that teachers introduce to their classroom. We must encourage social interactions that accurately communicate thoughts, feelings, or emotions so that when a child is offline, they can still make a better life for themselves.³⁰¹

➤ Teachers must show students how to access real information, show them how to verify its validity, and then encourage them to use it appropriately.³⁰²

Evaluation of Necessity of Technical Education for Human Resource Development

The significance of technical education is growing in contemporary economies due to the continuous advancement of technology and the rising complexity of enterprises. Technical education equips students with the requisite skills and information essential for employment in specialized professions and industries, hence facilitating instant job prospects and increased earning capacity. Additionally, it assumes a crucial function in facilitating economic expansion and advancement, addressing the disparity in skills within the labor market, and empowering persons hailing from underprivileged backgrounds. One of the primary facets of technical education is in its emphasis on equipping students with practical skills and comprehensive information essential for executing specified activities or fulfilling designated roles within a given profession or business. The acquisition of these skills and information is highly sought after and essential for those seeking to establish a prosperous professional trajectory. In light of the fast progress of technology, it is essential for people to possess the capacity to adapt and enhance their skill sets in order to sustain competitiveness within their respective domains. Technical education programs undergo regular updates to include the most recent advancements in technology and industry trends, enabling learners to maintain currency and pertinence in their professional pursuits.³⁰³ It can help to bridge the skills gap in the workforce. As technology continues to evolve, new skills are required to meet the

demands of different fields and industries. Technical education provides individuals with the necessary skills and knowledge to meet these demands, which can lead to increased productivity and economic growth. The ability of technical education is to empower individuals from disadvantaged backgrounds. Technical education can provide individuals from low-income families or underprivileged communities with the skills and knowledge needed to secure better-paying jobs and improve their standard of living. It is a powerful tool for personal and professional development and it allows individuals to grow and improve their skills over time. Such education can also play a vital role in driving economic growth and development. Technically skilled individuals can contribute to the growth of industries and companies, leading to the creation of jobs and increased productivity. This can help to revitalize communities and create a more sustainable and self-sufficient local economy. Moreover, it can also provide individuals with the skills and knowledge needed to start their own businesses, which can lead to economic development and job creation. Entrepreneurial opportunities can help to create jobs and promote economic growth, while also providing a sense of ownership and control over one's own life.

The only thing that can't be taken away is education. It is the key to making people's dreams come true. But because of the COVID-19 outbreak, 1.6 billion children have had to miss school and have had their learning interrupted. As learning losses keep going up, it is thought that 72 million primary school children will be in "learning poverty," which means they won't be able to read and understand an easy text by the age of 10. There is a chance that 24 million kids will never go to school again. Because of the pandemic, 10 million more girls will be at risk of getting married as children over the next ten years.³⁰⁴ A UN policy brief on the impact of COVID-19 on women says, 'Evidence from past epidemics shows that adolescent girls are at particular risk of drop out and not returning to school even after the crisis is over.' Online teaching and learning are the best solution. Alternately we need to design new methods to facilitate distance learning, including radio and TV education broadcasting in areas without internet.³⁰⁵ Computer technology is a form of machine as well. There is almost no aspect of life that has not been influenced by breakthroughs in computer science. Computer and communication technologies have altered the way people live. Previously, if someone wanted to learn anything, they would go to a school and study directly under an instructor. It is now feasible to

²⁹⁹ Christensen, K. S. (1999). A Comparison of Student Performance in Human Development Classes Using Three Different Modes of Delivery: Online, Face-to-Face, and Combined. Department of Education: Drake University, accessed on 28 Aug 2023

³⁰⁰ Collaborative asynchronous online learning, US Patent Office, 10 March 2014, Archived from the original on 8 June 2021, accessed on 28 Aug 2023

³⁰¹ Culén A et al, (2012), Tweens with the iPad classroom – Cool but not really helpful. International Conference on e-learning and e-technologies in education (ICEEE), (pp. 1-6). Technical University of Lodz, Poland, accessed on 28 Aug 2023

³⁰² Crane B., "Using Web 2.0 Tools in the K-12 Classroom". Neal-Schuman Publishers, Inc., 2009, accessed on 28 Aug 2023

³⁰³ <https://www.collegenp.com/article/technical-education-scope-types-courses-outcomes-importance/>, accessed on 12 Sep 2023

³⁰⁴ Alon T et al, (2020), "The Impact of COVID-19 on Gender Equality", available at: http://faculty.wcas.northwestern.edu/~mdo738/research/COVID19_Gender_March_2020.pdf, accessed 11 Sep 2023

³⁰⁵ <https://www.roomtoread.org/covid-19-response/>, accessed on 13 Sep 2023

attend classes and even get degrees without ever setting foot inside a school facility. Furthermore, non-degree learning, such as continuing education, test prep, and professional education, is now more accessible than ever thanks to new e-Learning and m-Learning technologies. Again, technical education is information about finer skills in life that provide pupils an advantage over mainstream schooling. Audio editing, video editing, voice modulation, recorded coddling, little programming, and so on are fascinating skill sets that need a finer and more sophisticated knowledge.³⁰⁶ These skills are usually found in students who are artistically inclined or have a softer side to their academic persona, allowing them to experiment and explore rather than follow the rules and stay within the lines. Students are breaking free of traditional career options like that of a general school/college teacher, manager, accountant, banker, business executive, doctor, lawyer, and instead of trying to make a break for jobs that require far more technical knowledge in different trade like electrician, mechanics, welder, fridge/AC mechanics, mobile/TV mechanics, digital marketing, e-banker, mason-man, digital sound or video editing, etc.³⁰⁷ About one-third of students in bachelor's degree programs change their college major at least once, with 1 out of every 10 student changing majors multiple times. A key reason for this is a lack of hands-on career exploration opportunities during high school. Without career-focused education, students don't have a clear picture of what a future job might actually be like.³⁰⁸ When you make decisions with little information, you're more likely to have to change your mind later on. But career and technical education is based on the idea of giving kids those hands-on chances with the clear goal of getting a job in mind. They get to learn about the field that goes with the course, get a feel for it, and do some work themselves. Only 54% of potential families are happy with their school's job study program, while almost 85% of families whose kids are in job and Technical Education (CTE) programs are happy with it.³⁰⁹ The necessity and advantages of technical education and study has been given below.

- Technical education encourages self-learning and independence.

- It offers employment opportunities that are skill-based and distinction.

- Technical education has various levels of studies and a lot of different degrees or certificates too. There are diploma levels, graduate degree levels, post-graduate degree levels, research levels, and even special industrial training institutes for technical education in the world.

- It offers specialized courses in different events in various technical fields. This is to adjust to the different sides of technological development and the following economic progress.

- The standard of technical education is maintained around the world with the help of international level councils and universities. They generally deal with forming standards and norms and keeping them consistent.

- Technical education is the knowledge and skills which can provide or assured sustainable income of human. These jobs pay well enough for individuals to live in society in comfortable manner.

- Many students of technical education have started their own companies or small-scale businesses and have managed to provide job opportunities to other educated hands as well.

- Technical education schemes do have brilliant opportunities for education, employment, and even internships for those who are new to the business or just want to try it out.

- It is the important tools to create small/medium entrepreneur.

- Technical education can also promote lifelong learning, which is essential for keeping up with the latest technologies and industry developments. This will allow individuals to stay current and relevant in their careers, and adapt to new technologies as they emerge.

It can also provide a pathway for social mobility, allowing individuals to move up the socioeconomic ladder and achieve a higher standard of living.

- Young student and children know their talents and strengths by that point in time. Many students/children of technical education opt for jobs while others opt to attend international technical

- All major industries in the modern world rely heavily on some form of data consumption or smart technology. This data could be about the clients, products, services or organizations. Being good at understanding multiple programs is a set of strong skills that won't go wrong at all. Many jobs require written communication. These often require people to explain things that are hard to understand.³¹⁰

- Good careers can be made out of technical education. An individual can also earn a respectable amount of money and status from a career in technical work or skill. A large chunk of this can be attributed to the modern world which is gaga over technology and the extremely rapid advancements that are made to it.³¹¹

- Normally, technical schools/institutes have a curriculum tailored to a particular job assignment, while conventional universities involve more extended coursework before acquiring a certain profession's skills. Technical schools/institutes are known to have

³⁰⁶ GLOBAL HUMANITARIAN RESPONSE PLAN COVID-19 UNITED NATIONS COORDINATED APPEAL APRIL – DECEMBER 2020, available at: <https://www.unocha.org/sites/unocha/files/Global-Humanitarian-Response-Plan-COVID-19.pdf>, accessed 11 Sep 2023

³⁰⁷ <https://byf.org/5-proven-benefits-of-career-and-technical-education/>, accessed on 12 Sep 2023

³⁰⁸ <https://nces.ed.gov/pubs2018/2018434.pdf>, accessed on 08 Sep 2023

³⁰⁹ https://cte.careertech.org/sites/default/files/AdvanceCTE_CommResearchReport_042721.pdf, accessed on 08 Sep 2023

³¹⁰ <https://abudhabi.globalindianschool.org/blog-details/classroom-strategies-for-child-development>, accessed on 12 Sep 2023

³¹¹ <https://abudhabi.globalindianschool.org/blog-details/raise-your-childs-knowledge-graph-with-these-simple-tips>, accessed on 12 Sep 2023

short courses with programs that can be finished within the year. Since there is less time to stay in college, vocational graduates can immediately join the workforce. In traditional colleges/universities where their programs can last for two or more years, their cost of attendance is undoubtedly expensive, and may even have huge loans by the time they graduate.³¹²

➤ Students who attend technical schools/institutes will gain specialized education to develop a particular skill set required for their future job. The program will involve several practical trainings before they can receive their certification. Unlike their 4-year counterparts, trade schools don't need general education subjects and are more focused on the abilities required for a particular profession. In universities, students sometimes get frustrated and delayed when they take up general education such as history, foreign languages, or English.

➤ Students who choose a trade school are almost always certain of the jobs they wish to pursue. These learners are determined to develop their skills and knowledge in particular areas. One of the main reasons students prefer to enroll in a trade school is its financial benefits. It is a lot cheaper than earning a degree from a university. Students can make huge savings since they have a shorter time in college and pay less for textbooks and miscellaneous expenses.

➤ Technical and vocational institutions concentrate more on job-focused, hands-on education in a specific trade or skill. Students can maximize the high-tech facilities in the classroom, which usually are close enough to their future job site. The curriculum of technical schools develops the abilities utilized in the job site and not the lecture room. With trade school, its objective is plain and simple—teach skills and provide the experience needed to succeed in the student's chosen job after graduation.³¹³

➤ As students go through their technical education in an actual environment, they become involved in resources and concepts. Such methods intensively prepare them for possible scenarios and problems they will encounter while working. Also, their hands-on training will teach them to work with their tools in an actual simulated environment. Students will learn practical safety from this administered but realistic learning environment.

It is widely acknowledged that throughout the course of the previous century, formal education saw a significant increase in both significance and breadth, as an increasing number of students made the decision to pursue higher education in disciplines such as medicine, engineering, and mathematics. A significant number of individuals pursued undergraduate and graduate degrees, subsequently obtaining lucrative professional positions in the white-collar sector. Currently, with the global shift towards equality, an increasing number of students are showing a preference for technical education. This kind of education provides practical infor-

mation and skills that are relevant to significant occupations, while also fostering the development of self-reliant individuals and entrepreneurs. Numerous worldwide educational institutions are now providing opportunities for pupils to cultivate their technical abilities and nurture their innate capabilities, starting at the elementary level. Presently, students attending foreign schools located in major cities such as New York, Moscow, Boston, Sydney, London, Delhi, Beijing, Abu Dhabi, Singapore, Malaysia, Hong Kong, Thailand, and others are required to make consequential choices on their professional paths prior to the culmination of their last year of high school, often referred to as the HSC or A level. This age seems to be rather early; nonetheless, it is often observed that children typically possess an awareness of their abilities and strengths throughout this developmental stage. It is noteworthy that a significant number of students pursuing technical education choose to pursue employment opportunities, while another group chooses to enroll at prestigious worldwide technical institutions such as Caltech and MIT, among others. Degree programs or certificate courses offered by local technical schools are comparatively more affordable than traditional four-year programs offered by institutions. The primary factor contributing to this phenomenon is the comparatively short duration of technical training. In addition, these programs provide students the advantage of instantly entering the job within their chosen field. Therefore, this kind of education provides advantages for a large number of young pupils. High schools that prioritize technical education often provide a greater breadth of career guidance to their pupils compared to those that emphasize traditional academic topics. Typically, this includes a greater number of career counseling sessions, courses focused on skill enhancement, and increased availability of guidance from educators to students. Numerous prestigious technical schools maintain affiliations with higher education institutions and enterprises that consistently seek new talent for their technical departments. It is well acknowledged that the progress of a country is contingent upon the efficient exploitation of both human and physical resources, which in turn relies on the training and development of its workforce. Let us examine a nation such as Bangladesh. Bangladesh, being the country with the 8th biggest population globally, has a challenge in terms of the adequacy and significance of its technical workforce relative to its population size. Technical education primarily focuses on the cultivation and enhancement of practical skills. Skilled workers definitely increase productivity.³¹⁴

Technical education and technological expertise play a crucial role in the nation's human resource development. This form of education not only generates a skilled workforce but also boosts productivity and enhances the overall quality of life for the population. In the 21st century, amid the age of science and technology, it is essential to produce qualified individuals capable of meeting the demands of our rapidly advancing

³¹² <https://collegecliffs.com/10-benefits-technical-trade-school/>, accessed on 12 Sep 2023

³¹³ <https://byf.org/5-proven-benefits-of-career-and-technical-education/>, accessed on 12 Sep 2023

³¹⁴ <https://abudhabi.globalindianschool.org/blog-details/the-importance-of-technical-knowledge-in-the-modern-world>, accessed on 13 Sep 2023

world. The link between a nation's technical or vocational education system and its socio-economic progress is undeniable. In countries like Bangladesh, only about 30% of students pursue technical vocational education, a significantly low figure when compared to many developed and even some developing nations. To address this disparity, there is a pressing need to shift the mindset of both parents and students, encouraging them to prioritize technical education over general education. Currently, there are millions of educated young people in the country who are unemployed. This unemployment poses a considerable burden on the nation and its society, leading to frustration among these youths. In some cases, this frustration escalates into criminal activities and substance abuse. The global demand for skilled workers is on the rise, not only in developed countries but also in regions like the Middle East where a significant number of Bangladeshi workers are employed in unskilled positions. It is imperative for nations to invest in technical education to meet this growing demand for skilled labor and ensure the future prosperity of their citizens.³¹⁵

Technical education enables individuals to obtain the necessary skills and information that are vital for the betterment of both society and business. The fast industrialization of Japan may be attributed to the collection of technical skills, knowledge, and know-how, as well as its strong dedication to education, notably in the training of technical professionals. Technical education plays a crucial role in enhancing analytical and functional capabilities, as well as improving efficiency, skills, knowledge, and profitability. These aspects are of utmost importance for the economic growth of any nation. Now we live in a century of technologies, where we found the application of technologies in every aspects of life. Technology has become an integral part of our everyday lives, to the extent that its absence may lead to a sense of unease and inconvenience. In Bangladesh, a significant number of individuals pursue higher education; yet, they have challenges in securing employment opportunities due to a dearth of marketable skills and technical expertise. Technical education equips individuals with specialized knowledge and skills in a certain subject, enabling them to establish their own enterprises and achieve self-employment. Technical education has a crucial role in mitigating unemployment by equipping individuals with specialized skills, therefore contributing to the overall economic progress of a nation. The advancement and economic development of any nation are contingent upon industrialization. Technical education equips individuals with the necessary abilities to effectively operate and build industrial enterprises. Countries have the potential to significantly reduce their foreign currency expenditures by possessing competence in technical knowledge and the necessary skills. In order to facilitate the development of a nation, it is essential to provide a wide range of educational programs that cater to diverse fields of study. This approach ensures a balanced distribution of skilled professionals throughout

various sectors, enabling a significant portion of the population to contribute to the country's economic growth via their respective professions. The primary aims of technical education typically encompass the provision of instruction for the purpose of employment and occupation of the workforce, contributing to the sustainable development of the nation, equipping individuals with skills for income generation, fostering small business ventures and entrepreneurship, imparting essential scientific knowledge to address environmental challenges, cultivating a cadre of individuals capable of comprehending and adapting to emerging technologies, and facilitating economic growth through the cultivation of skilled human resources.³¹⁶

Technical education encourages workforce growth and provides individuals with skills that will help them to produce, develop, and establish industries across the nation. It also encourages rivalry among manufacturers of products and services, which leads to improved technology. Better technologies result in lower manufacturing costs and higher profits for entrepreneurs. As a result, the entrepreneur may use this money to start a new firm or expand an existing facility or business. As a consequence, they create more jobs and produce more products and services, increasing the entrepreneur's profit. Investing such profits will expand both employment and output of products and services. This cycle will continue indefinitely. That is, those who work in society assist to better their economic situation and so contribute to the country's economic progress. Again, technical education contributes to the decrease of poverty and economic inequality in society. With increasing economic disparity, the crime rate, rioting, violence, and robbery rise. Every nation should guarantee social fairness. Individuals with strong talent earn more, whereas those with little or no skill receive less. Technical education teaches individuals skills that serve to reduce economic disparity among people. As a result, in order to eliminate poverty and economic disparity, the government must place a greater emphasis on technical education. Technical education educates people to become specialists in their fields, allowing them to create their own businesses or become self-employed, making society self-sufficient and entrepreneur countries self-sufficient.

By giving people skills, training, and better tools, technical education also helps to make people more productive. When production goes up, resources are used more efficiently, resources aren't wasted, and the country makes more money. People can use the money to make things, and the country can grow and get better. It also saves the country's foreign cash by making the best use of its natural resources and people. Technical schooling also helps cut down on the number of people who need help. It also helps a lot of people work for themselves. It makes more people work in families and across the country. In the end, it raises people's living standards by giving them more money, which leads to the economic growth of a country. Technical education

³¹⁵ <https://thefinancialexpress.com.bd/views/why-technical-education-is-imperative-1580483097>, accessed on 13 Sep 2023

³¹⁶ <https://thefinancialexpress.com.bd/views/why-technical-education-is-imperative-1580483097>, accessed on 13 Sep 2023

is an important part of a country's social growth because it gives people the skills, information, attitudes, and ways of thinking that they need. The lack of technical education leads to unemployment, which makes people angry, which in turn raises the crime rate or drug abuse in society and slows down social progress. In reality, technical schooling gives people skills that make them useful or self-sufficient. The job situation changes all the time these days. People who are working now are being thrown out of the market because the demand for their skills is always changing. To keep up with these changes, everyone had to keep their knowledge and skills up to date by training and learning new skills. As you can see, technical schooling is a great way to keep society healthy. Sustainable development is growth that will last for many generations and be useful for a very long time. People's wants must be met for sustainable growth to happen. This means that people can have a better quality of life without sacrificing their future. Sustainable growth is made up of three main parts. Social sustainable development means it must maintain adequate health, education and other services. It must maintain equality of gender, equal opportunity and distribution, participation and accountability in politics.

- An environmentally sustainable system must maintain bio-diversity, avoids over exploitation of conventional resources, maintain and protect environment, maintain stability of natural resources and atmosphere.

- An economically sustainable system must produce goods and services continuously, maintain external and government debts to manageable extents, and avoid things that disturb balance in sector which can leads to damage in agricultural and industrial production.

Technical education prepares students for careers in a variety of professions and sectors, many of which are in great demand. Individuals may remain competitive in their areas by staying up to speed with the newest technology and industry advancements via technical education. Individuals with technical skills may help sectors and businesses thrive, resulting in job creation and higher production. Individuals from low-income households or impoverished areas might benefit from technical education by acquiring the skills and knowledge required to acquire better-paying employment and enhance their quality of life. Technical education programs should be tailored to the specific needs of disadvantaged communities, such as offering programs relevant to the community's prevalent industries and providing training and support for individuals who may lack basic education or have limited English proficiency. In addition to offering technical education, it is critical to concentrate on the entire development of disadvantaged communities by providing access to healthcare, housing, and other types of assistance, all of which may contribute to the creation of a stable and supportive environment in which people can flourish. Indeed, technical education may assist to reduce the consequences of automation by equipping people with new skills and knowledge that will be in high demand in the future. As technology advances and many occupations become more automated, it is becoming more

vital for people to have a varied range of talents that are not confined to a single profession or business. Technical education programs that concentrate on delivering transferable skills across sectors might help students be more adaptable to work market changes.

People in the future workforce will need both technical and non-technical skills, and people with a good mix of both will be in high demand. People can learn the technical skills they'll need in the future while also improving their problem-solving, "soft skills," and other important skills through technical schooling. Technologists and engineers come up with new ideas and work on making products that help people. For a country's economy to grow, it needs new technologies, better technologies, new ideas, creative thought, skills, and trained skilled workers. The creation of new items creates job opportunities. When more people are working, they have more money to spend on things like health care and schooling, which is good for the nation's social and economic growth. When people get the right education, they can easily understand, become more polite, and move forward. Getting educated gives you skills and makes life better. If everyone in the country went to school, it would grow. When creating a product, we need to think about how to make the best use of resources by protecting the earth and making sure that resources are always available. Technologists and engineers are very important to sustainable development because they help solve problems like pollution, population growth, running out of natural resources, finding the right tools, and so on. Technologists and engineers today think about how their work affects people, the economy, and the world. People are drastically changing natural resources in order to meet the wants of society. This makes it very hard to balance the needs of people with the needs of the world ecosystem. Technologists and engineers play a big part in making sure that society's needs, health, and well-being are met with little to no waste of resources, all while protecting the earth and making sure that resources last. In the end, technical schooling is necessary for any country to grow its economy and stay developed. Technical schooling can help lower unemployment, save money on foreign exchange, fight poverty, and level the playing field for everyone. It teaches people the skills they need to be good, responsible members of a country. Making the best use of a country's natural resources is important for its growth. Productivity is a measure of how well people are living and how much a country has grown. A country with a high production score makes better use of its natural resources and can do better economically. To turn a country's natural resources into useful goods, it needs skilled workers, and technical schooling is the best way to get those workers. As a result, a country can only grow and succeed in the long term if its expert and skilled workers can be hired by other countries and even by sending money back to the country as income.

Conclusion

We live in a digital and smart era, and digitization and smart technology have permeated practically every area of our lives. It has become a part of our daily lives. Digital and smart technologies are also becoming at-

tractive areas of study. This will also serve as a distraction from the monotony of the classroom, books, and notes. Use software, videos, e-learning books, audio books, podcasts, and other media to educate and expand the knowledge of children and young pupils. The internet has also provided us with tools that allow students to attend online classes and take quizzes, exams, and worksheets. This whole experience has been both enlightening and satisfying. Parents may urge their children to utilize their mobile devices and computers to study instead of spending lengthy hours playing video games. Visual and auditory aids are one of the several methods in which a youngster may study and expand their knowledge. These auditory and visual modalities make learning considerably more engaging and novel. In reality, technology is creating new avenues for today's students to study. There are three types of intelligence that we observe in children today: emotional intelligence, creative intelligence, and instructional intelligence. The conventional classroom atmosphere, which favors lecture-based courses, favors the latter choice. Standardized exams and comparable rating systems do the same thing. When kids have access to technology as we have today, individuals who flourish outside of the traditional learning environment may still reach their full potential. Technology enables youngsters to express their curiosity in a variety of ways. Because they have access to technology, they can attempt new activities without fear of being humiliated. It enables pupils to work via trial and error as they see fit, allowing them to learn more successfully. Technology enables and provides students with convenient access to data and research resources from a single place. It enables a student to get all of the materials they need for a project from a single source. Instead of wasting time looking for something particular or waiting for their library to order it, students may use Google or another search engine to obtain their supporting resources and information.

The education field has always been the last to make big changes, sticking to old ways of teaching and technology. But as schools become more digital and use smart technology, teachers are adding new, more advanced features. Over time, students are becoming less interested in traditional ways of teaching and more interested in eLearning and digital change. Our whole school system will move forward as more and more digital and smart trends take hold. Besides money problems, education has other resource problems as well. As we all know, school days are limited, and teaching time is very valuable. Many students around the world spend more time in school than students in the US, Japan, and Germany. However, students in these countries usually spend less time in school. New developments in testing technology might be good for both teachers and students. That way, teachers won't know if their students have understood the lesson and lawmakers won't know if their changes have worked. Since the optical scan answer sheet was first made fifty years ago, assessment technology hasn't changed much, if at all. New tools for testing can help lower the cost of testing, and some of them let tests be given accurately in real time. Thanks to improvements in tests, students can be graded in a setting with low risks. Students who know about the newest technology advances will be able to learn more

about many subjects and gain new skills they can use in the future. Also, these students will have a better chance of getting a job because they will know a lot about the newest trends in many fields. They will also be able to help modern businesses and organizations become more efficient thanks to their smart knowledge and skills.

Technical education plays a crucial role in mitigating the skills gap within the labor market, as it equips people with the requisite expertise and understanding to effectively address the diverse requirements of various sectors, services, and industries. Technical education has the potential to provide students with the necessary skills and knowledge required to initiate entrepreneurial endeavors, therefore fostering economic growth and facilitating the generation of employment opportunities. Acquiring new skills and information that are anticipated to be in high demand in the future might assist people in reducing the consequences of automation. The inclusion of technical education may effectively facilitate the cultivation of lifelong learning, a crucial component in remaining abreast of contemporary technology and advancements within the industrial sector. Ensuring the accessibility and affordability of technical education for persons hailing from underprivileged areas is essential. This may be achieved via the provision of financial assistance, scholarships, and many other types of support. Technical education programs often include practical projects and real-world problem-solving exercises, enabling students to effectively utilize their technical abilities in addressing tangible global challenges. Therefore, it is imperative that these programs be intentionally crafted to foster inclusivity and cultural sensitivity, so guaranteeing a sense of acceptance and assistance for those hailing from marginalized areas. These programs need to provide supplementary assistance to students outside of the traditional classroom setting, including services such as career counseling, job placement assistance, mentoring initiatives, and similar provisions. In the contemporary economy, acquiring skills and knowledge is of utmost importance as it equips people with the necessary tools to thrive in a society characterized by fast change and technological advancement. The aforementioned factor assumes a crucial function in stimulating economic expansion and advancement, facilitating the reduction of skill disparities within the labor market, and enabling persons from marginalized backgrounds to gain agency and autonomy. Ensuring accessibility, affordability, and inclusivity of technical education is crucial in order to provide equal opportunities for all individuals to access and excel in such educational pursuits. The technology in question has significant potential for both personal and professional advancement, playing a crucial role in the overall progress and maturation of society. Advanced technology, such as digital and smart technologies, has both advantages and disadvantages in the field of education. However, it is important to acknowledge that these limits are inevitable and should not be disregarded. In the next years, technical education is expected to have a crucial role in fostering both individual and national economic growth.

TECHNICAL SCIENCES

УДК 629.78

DEVELOPMENT OF A MINIATURE ELECTRON-OPTICAL INSTRUMENT FOR NANOSATELLITE BASED ON THE «SYNERGY» PLATFORM FOR RESEARCHING THE NORTH-WEST REGION OF RUSSIA

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РАЗРАБОТКА МИНИАТЮРНОГО ЭЛЕКТРОННО-ОПТИЧЕСКОГО ПРИБОРА ДЛЯ НАНОСПУТНИКА НА ОСНОВЕ ПЛАТФОРМЫ "СИНЕРГИЯ" ПО ИЗУЧЕНИЮ СЕВЕРО-ЗАПАДНОГО РЕГИОНА РОССИИ

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Abstract

Methods for filtering the high-frequency component of an image were studied in the work. Based on the simulation results, it was found that a high-pass filter copes with this task most effectively: butterworth filter, which can quickly perform processing, and after its application the image retains a large informative component. Ideal and Gaussian high-frequency filters also showed acceptable results; they are only slightly inferior in performance and preservation of the information content of image elements. Difference filters turned out to be less effective, showing the longest processing time, and after their application a large amount of useful information can be lost.

Аннотация

В работе исследованы методы фильтрации высокочастотной составляющей изображения. По результатам моделирования установлено, что наиболее эффективно с этой задачей справляются фильтр высоких частот: фильтр Баттерворта, способный быстро выполнять обработку, а после его применения изображение сохраняет большую информативную составляющую. Также приемлемые результаты показали идеальный и Гауссов высокочастотные фильтры, они лишь немного уступают в быстродействии и сохранении информативности элементов изображения.

Разностные фильтры оказались менее эффективны, показав наибольшее время обработки, а также после их применения может теряться большой объем полезной информации. Работа выполнена при финансовой поддержке гранта Российского научного фонда, Санкт-Петербургского научного фонда (соглашение № 22-29-20186 и № 03/2022).

Keywords: nanosatellite, Synergy platform, cubesat, electronic optical device remote sensing, noise filtering

Ключевые слова: сверхмалый космический аппарат, наноспутник, платформа «Синергия», cubesat, ДЗЗ, фильтрация шумов

Введение

Автоматическая обработка изображений представляет большой интерес при анализе объектов со спутниковых снимков. При этом изображения подвергаются искажению (шумам) в процессе их получения с электронно-оптических приборов (ЭОП). Адаптивная фильтрация позволяет восстановить повреждённое изображение без потерь информации. Таким образом повышение качества изображений является одним из перспективных видов цифровой обработки. Коллектив лаборатории «Астрономикон» проводит работы по разработке ЭОП для мониторинга Северного-Западного региона РФ при помощи наноспутника на основе платформы «Синергия», в частности, Северного Морского пути;

следовательно, базовой единицей такого устройства является светочувствительная матрица. Она производит преобразование проецированного на неё оптического изображения в электрический сигнал для дальнейшей обработки. При этом существует два различающихся типа матриц – КМОП и ПЗС, каждая из которых обладает своими достоинствами и недостатками. Оба типа оптических датчика делают одно и то же – трансформация изображения, отличие заключается в том, на основе каких процессах они это делают.

ПЗС-матрицы

ПЗС-матрица – Прибор с Зарядовой Связью (в англоязычной терминологии CCD [1]). Данный тип

матриц широко используется в фото- и видеокамерах, а также в сканерах. Принцип работы ПЗС заключается в следующем: светочувствительные элементы (пиксели) работают как копилка для электронов. Электроны возникают в пикселях под действием света, то есть проецированного изображения. В течение определённого времени в каждом пикселе образуется некоторое количество электро-

нов, пропорционально количеству света, попавшего на него, а затем электрические заряды, собравшиеся в каждом пикселе, последовательно передаются на выход ЭОП и измеряются. Описанный механизм осуществим за счёт определённого положения светочувствительных элементов и электрической схемы управления на кристалле. Структурная схема ПЗС-матрицы приведена на рис.1.

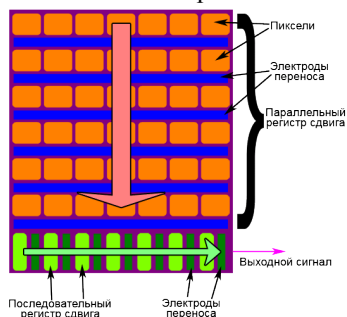


Рис. 1. – Структурная схема ПЗС-матрицы.

После проецирования изображения на матрицу, электронная схема управления с помощью набора импульсных напряжений сдвигает столбцы со скопленными в пикселях электронами к краю матрицы. Там находится похожий по механизму работы ПЗС-регистр, где заряды сдвигаются в перпендикулярном направлении и попадают на измерительный элемент, в котором создаются сигналы пропорционально поступившим отдельным зарядам. Зная какой заряд и в какой момент времени поступил, можно рассчитать какому пикселю он соответствовал.

КМОП-матрицы

КМОП-матрица – Комплементарный Металл-Оксид-Полупроводник (в англоязычной терминологии CMOS [2]). Причем данные устройства различают по внутренней архитектуре, например, роль фоточувствительных элементов могут играть фотодиоды, фототранзисторы или фотовентили. В отличие от ПЗС, технология КМОП позволяет производить больше операций на самом кристалле, где находится фоточувствительная матрица. Кроме простой фиксации электрона и его передачи

КМОП-сенсоры способны обрабатывать изображения, выделять контуры, уменьшать помехи и проводить аналого-цифровые преобразования. Столь широкий набор функций, выполняемых одной микросхемой — основное преимущество технологии КМОП над ПЗС. При этом сокращается количество необходимых внешних компонентов. Использование в цифровой камере КМОП-сенсора позволяет устанавливать на освободившееся место другие компоненты, например, цифровые сигнальные процессоры (DSP) и аналого-цифровые преобразователи.

При использовании КМОП-технологии каждый пиксель имеет свой считывающий транзисторный усилитель, что позволяет преобразовывать заряд в напряжение прямо на самом пикселе. Вдобавок это позволило получить произвольный доступ к каждому пикселю матрицы. В отличие от ПЗС, где заряды считываются последовательно, в КМОП считывание происходит по параллельной схеме. Произвольный доступ позволяет КМОП-матрице считывать отдельные области пикселей (метод оконного считывания).

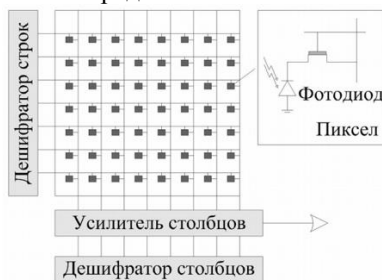


Рис. 2. – Структурная схема КМОП-матрицы.

Несмотря на указанные преимущества КМОП-матриц перед ПЗС (основным из которых является более низкая цена) они обладают и рядом недостатков. Наличие дополнительных схем на кристалле КМОП-матрицы приводит к появлению ряда помех, таких как транзисторные и диодные рассеивания, а также эффект остаточного заряда, то есть

КМОП-матрицы являются более «зашумленными» [3].

Источники шумов на изображении

Для определения к какому виду принадлежит наблюдаемый шум необходимо знать его пространственные или частотные характеристики, а также выяснить: присутствует ли корреляция между изоб-

ражением и шумом. В первом приближении мы допускаем, что шум не зависит от пространственных координат, а корреляция между шумом и изображением отсутствует. При моделировании шума используют статические свойства яркости шума, а значения яркости являются случайно величиной с заданной функцией плотности распределения.

Аддитивный Гауссов шум

Представляет собой добавление к каждому пикселю изображения значений из соответствующего нормального распределения с нулевым средним значением.

Функция плотности распределения вероятностей: $p(z) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left(-\frac{z^2}{2\sigma^2}\right)$, где z – значение яркости, σ – среднеквадратичное отклонение яркости.

Данный шум возникает ещё на этапе формирования изображений. Классические линейные фильтры позволяют эффективно удалять гауссов шум, но при этом размываются мелкие детали.

Импульсный шум

Характеризуется заменой некоторых пикселей на изображении значениями фиксированной или случайной величины. Функция плотности распределения вероятностей: $p(z) = \begin{cases} P_a, z = a \\ P_b, z = b \\ 0, z \neq a \vee z \neq b \end{cases}$.

При $b > a$, пиксель с яркостью b – светлая точка, соответственно пиксель, яркость которого равна a , выглядит как темная точка. Если одна из вероятностей P_a или P_b равна нулю, то шум называется униполярным. Если $P_a = P_b \neq 0$, то шум представлен хаотично расположенными по изображению черными и белыми точками, что походит на крупинцы соли и перца, это послужило появлению второго названия этого шума – шум «соли и перца».

Данная модель шума характерна для систем передачи изображений по радиоканалам с использованием нелинейных видов модуляции и для цифровых систем передачи и хранения информации [4]. Для устранения импульсного шума используется специальный класс нелинейных фильтров, построенный на основе ранговой статистики [5].

Экспоненциальный шум

Функция плотности распределения вероятностей: $p(z) = \begin{cases} a \exp(-az), z \geq 0 \\ 0, z \leq 0 \end{cases}$.

Характерен для изображений, полученных с помощью лазерных технологий.

Равномерный шум

Функция плотности распределения вероятностей: $p(z) = \begin{cases} \frac{1}{b-a}, a \leq z \leq b \\ 0, a \geq z \vee b \leq z \end{cases}$.

Математическое ожидание $\mu = \frac{a+b}{2}$, дисперсия $\sigma^2 = \frac{(b-a)^2}{12}$.

Вышеупомянутые распределения позволяют моделировать искажения, вызванные широким спектром шумов.

Определение вероятностных характеристик зашумлений

При работе с шумом не всегда заранее известны его параметры, поэтому существуют способы определения вида при помощи однородных по яркости тестовых снимков. Если нет возможности получить тестовые изображения, то прибегают к анализу гистограммы небольшого по яркости участка изображения. Для него вычисляются математическое ожидание и дисперсия: $\mu = \sum_{z_i \in S} z_i p(z_i)$, $\sigma^2 = \sum_{z_i} (z_i - \mu)^2 p(z_i)$, где z_i – значения яркости пикселя из окрестности S изображения, $p(z_i)$ – нормализованные значения гистограммы.

С помощью гистограмм можно определить, какой из функций вероятностей ближе всего можно описать наблюдаемый шум.

Методы фильтрации шумов

Существует большое разнообразие фильтров, которые можно классифицировать по области, в которой они работают:

1. Пространственные фильтры.
2. Частотные фильтры.

Далее приведено исследование методов фильтрации изображений с точки зрения решения задачи шумоподавления и предложение по разработке алгоритма адаптивной фильтрации, реализуемой на базе алгоритмов машинного обучения. В данном разделе проводится обзор существующих фильтров, способных выполнять задачу повышения качества изображения с целью дальнейшего исследования существующих методов фильтрации.

Пространственные фильтры

Математическое описание пространственных фильтров представляется в виде двумерной свёртки изображения A маской h : $\hat{f}(x, y) = h(i, j) \times \times A(x, y) = \sum_i \sum_j h(i, j) A(x - i, y - j)$.

Результатом является изображение $\hat{f}(x, y)$. Как правило, ядро фильтра отличается от нуля только в некоторой окрестности N точки $(0, 0)$. За пределами этой окрестности $h(i, j)$ равняется нулю или очень близко к нему и им можно пренебречь. Суммирование производится по $(i, j) \in N$ и значение каждого пикселя $\hat{f}(x, y)$ определяется пикселями изображения A , которые лежат в окне N , центрированном в точке (x, y) (обозначение – множество $N(x, y)$). Ядро фильтра, заданное на прямоугольной окрестности N может рассматриваться как матрица m на n , где длины сторон являются нечетными числами. При задании ядра матрицей ее следует центрировать. Если пиксель (x, y) находится в окрестности краев изображения, то координаты $A(x - i, y - j)$ для определенных (i, j) могут соответствовать несуществующим пикселям A за пределами изображения. У данной проблемы существует несколько решений:

- для краевых пикселей не производить фильтрацию, при этом обрезав края изображения или заменить их исходными значениями краевых пикселей изображения A .

- не включать отсутствующий пиксель в суммирование, распределив его вес $h(i, j)$ равномерно среди других пикселей окрестности $N(x, y)$.

- с помощью экстраполяции определить пиксели за границами изображения.

- применив зеркальное продолжение изображения доопределить пиксели за границами изображения.

Выбор способа производится с учётом конкретного фильтра и особенностей изображения [6].

Медианная фильтрация

Медианная фильтрация [3,7] определяется следующим выражением: $\hat{f}(x, y) = \frac{med}{(s,t) \in S_{xy}} \{g(s,t)\}$, где: S_{xy} – окрестность, x, y – координаты пикселей.

Результатом фильтрации является медианное значение из ряда значений всех пикселей области, форма которой определяется маской фильтра. Медианные фильтры пользуются популярностью из-за их меньшей способности размывать объекты, по сравнению с линейными фильтрами. Такие фильтры эффективно справляются с шумами, воздействующими на отдельные пиксели.

Кроме вышеперечисленных достоинств медианная фильтрация обладает некоторыми недостатками. Данный метод малоэффективен при фильтрации так называемого флуктуационного шума. К тому же увеличение размера маски ведёт к размытию контуров изображения, что означает снижение чёткости изображения. Вышеперечисленные недостатки минимизируются при использовании медианной фильтрации с динамическим размером маски.

Адаптивные медианные фильтры

Данный фильтр [3,8] действует в прямоугольной области точки $(x, y) - S(x, y)$. Отличие фильтра от медианного в том, что при необходимости изменяются размеры области воздействия в соответствии с приведёнными ниже условиями. Введём следующие обозначения:

z_{xy} - значение яркости в точке

z_{min} минимальное значение яркости в окрестности

z_{max} максимальное значение яркости в окрестности

z_{med} - медиана значений яркости в окрестности

S_{max} максимальный допустимый размер.

Алгоритм состоит из двух ветвей:

Ветвь 1: Пусть $A_1 = z_{med} - z_{min}$, $A_2 = z_{med} - z_{max}$;

Если $A_1 > 0$ и $A_2 < 0$, то переход к ветви 2, иначе увеличить размер окрестности;

Если размер окрестности $\leq S_{max}$ повторить ветвь 1;

Иначе результат равен z_{med}

Ветвь 2: $B_1 = z_{xy} - z_{min}$, $B_2 = z_{xy} - z_{max}$;

Если $B_1 > 0$ и $B_2 < 0$, результат равен z_{xy} ;

Иначе результат равен z_{med} .

Применение данного фильтра преследует несколько целей:

1. Удалить биполярный импульсный шум.
2. Обеспечить сглаживание шумов других типов.
3. Свести к минимуму такие искажения, как чрезмерное утончение или утолщение границ объектов.

Значения z_{min} и z_{max} воспринимаются алгоритмом как «импульсные» составляющие шума.

Первая ветвь выполняет проверку медианы: является ли она импульсом, а вторая – является ли значение яркости в центральной точке окрестности импульсом. Если z_{xy} – не импульс, то результатом будет z_{xy} , в другом случае результатом будет значение медианы. По сравнению с медианным фильтром, адаптивный алгоритм позволяет сохранить больше деталей изображения.

Адаптивный метод нелокального среднего

Данный метод был предложен А. Buades в статьях [9,10,11]. При использовании большинства сглаживающих методов, помимо устранения шума, происходит и сглаживание деталей и резких перепадов изображения (контуров). В этом методе используется свойство схожести областей изображений, что показывает хорошие результаты при обработке текстурных изображений.

В методе нелокального среднего используется замена зашумлённой области изображения на взвешенную сумму похожих блоков. Это среднее число сохраняет целостность изображения, но уменьшает его маленькие колебания, которые происходят из-за шума [11].

Значения весов вычисляются в соответствии с выражениями [12]: $w_{qk} = \frac{1}{z_{qk}} * e^{-\frac{\|R_p - R_{qk}\|_2}{h^2}}$, $k =$

$\overline{1, P}$, $z_{qk} = \sum_{k=1}^P e^{-\frac{\|R_p - R_{qk}\|_2}{h^2}}$, где R – квадратный блок изображения размером $n \times n$ пикселей; $\|\cdot\|_2$ – евклидова норма; p – номер текущего блока; q – номер похожего блока; P – количество похожих блоков для усреднения; h – параметр сглаживания.

Для выбора правильных параметров нужно иметь информацию о характеристиках шумовой составляющей. Метод нелокального среднего эффективно применяется на изображениях с текстурой или областями с постоянной яркостью [12]. Если изображение сильно неоднородно по яркости, то данный метод крайне неэффективен.

Методы частотной фильтрации

В основе частотных методов лежит спектральный анализ, который представляет собой разложение сложного полезного сигнала на некоторое множество простых сигналов (колебаний) для определения интенсивности каждого простого сигнала в сложном. Между характером корреляционной функции и внутренней структурой соответствующего ей случайного сигнала существует связь [13]. Вид корреляционной функции зависит от того, какие частоты и в каких пропорциях преобладают у случайного процесса.

Ряд Фурье для двумерного сигнала: $\tilde{Y}_{x,y} = \frac{1}{N \cdot M} \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} Y_{k_1 k_2} * \exp(j * \frac{-2\pi}{N} * x * k_1 + j * \frac{-2\pi}{M} * y * k_2)$, $j = \sqrt{-1}$, $k_1 = \overline{0, N-1}$, $k_2 = \overline{0, M-1}$.

Базисные функции этого двумерного представления – двумерные комплексные экспоненты. Ко-

эффиценты Фурье $\tilde{Y}_{x,y}$ образуют двумерный частотный спектр сигнала $Y_{k_1 k_2}$ и называются формулой прямого преобразования Фурье [3,4,14].

Выражение, восстанавливающее сигнал $Y_{k_1 k_2}$ по его спектру $\tilde{Y}_{x,y}$, является обратным преобразованием Фурье и имеет вид: $Y_{k_1 k_2} = \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} \tilde{Y}_{x,y} * \exp(j * \frac{2\pi}{N} * x * k_1 + j * \frac{2\pi}{M} * y * k_2)$, $j = \sqrt{-1}$, $k_1 = \overline{0, N-1}$, $k_2 = \overline{0, M-1}$.

Обычное преобразование Фурье обладает весомым достоинством, с его помощью можно выполнять стационарную фильтрацию сигналов [3]. Для этого необходимо получить частотный спектр сигнала и частотный коэффициент передачи фильтра, а затем, перемножив их, получим частотный спектр выходного сигнала. В завершении требуется выполнить обратное преобразование Фурье и найти выходной сигнал.

Винеровская фильтрация

В основе принципа лежит использование всех значений пикселей при обработке каждой точки изображения. Фильтр Винера является одним из вариантов линейной некаузальной фильтрации изображений [16,18]. В случае Винеровской фильтрации предполагается, что известны дискретные корреляционные функции полезной $R_S(i, j)$ и шумовой $R_\eta(i, j)$ составляющих, а также их взаимные дискретные корреляционные функции $R_{S\eta}(i, j) = R_{\eta S}(i, j)$ [18].

Винеровская фильтрация применяется с целью получения оценки полезной составляющей $\tilde{S}_{i,j}$ в качестве отклика стационарной линейной системы [18]: $\tilde{S}_{i,j} = \sum_{i=1}^N \sum_{j=1}^M Y_{i-i,j-j} * H_{i,j}$, $i = \overline{1, N}$, $j = \overline{1, M}$, где $H_{i,j}$ - двумерная импульсная характеристика.

Критерием оптимальности является минимум среднего квадрата ошибок: $\sum_{i=1}^N \sum_{j=1}^M (Y_{i,j} - \tilde{S}_{i,j})^2 \rightarrow \min$, $\sum_{i=1}^N \sum_{j=1}^M (Y_{i,j} - \sum_{i=1}^N \sum_{j=1}^M Y_{i-i,j-j} * H_{i,j})^2 \rightarrow \min$.

При выводе уравнения фильтра допускается, что ошибка фильтрации не зависит от входного воздействия, тогда уравнение Винера-Хопфа дискретного фильтра Винера имеет вид [18]: $R_{YS}(i, j) = \sum_{i=1}^N \sum_{j=1}^M R_Y(i, j) * H_{i,j}$.

При решении полученного уравнения относительно всех неизвестных коэффициентов получаем импульсную характеристику фильтра, осуществляющего минимизацию среднего квадрата ошибок. В векторной форме решение имеет вид: $H_{\text{опт}} = R_Y^{-1} R_{YS}$.

Анализируя данное выражения видно, что минимальная ошибка фильтрации будет зависеть от формы полезной составляющей, матрицы взаимной корреляционной функции полезной составляющей и входной последовательности.

При отсутствии априорной информации о полезной и шумовой составляющих сильно осложняется использование Винеровского подхода обработки изображений. Расчёт оптимальной импульсной характеристики фильтра Винера предполагает

наличие полной априорной информации о полезной и шумовой составляющих [3]. Также накладываются дополнительные условия на взаимные корреляционные матрицы полезной и шумовой составляющих и вектор взаимной корреляции R_{YS} , которые на практике выполняются со значительными допущениями [18].

Вейвлет-анализ

Одной из разновидностей спектрального анализа является Вейвлет-анализ, в котором вместо простых колебаний используются функции особого рода, которые называются вейвлетами. Это функции изменяющейся частоты и ограниченные по времени. Вейвлет-преобразования оказались эффективной альтернативой преобразованию Фурье в различных практических приложениях благодаря их способности к адаптации при анализе нестационарных сигналов. Главные его применения – сжатие данных и подавление шумовых составляющей [3].

При применении вейвлет-преобразования нестационарный сигнал анализируется с помощью разложения по базисным функциям, полученным из некоторого прототипа путём сжатия (растяжения) и сдвигов. Функцию-прототип называют материнским вейвлетом и выбирают для исследования данного конкретного полезного сигнала [17].

Для использования двумерного вейвлет-преобразования необходимо иметь двумерную масштабирующую функцию $\varphi_{k_1 k_2} = \varphi_{k_1} * \varphi_{k_2}$ и три двумерных вейвлет-функции, которые измеряют вариации функции – изменение яркости для изображения по разным направлениям: $\psi^H_{k_1 k_2} = \psi_{k_1} * \varphi_{k_2}$ - вариации вдоль столбцов, $\psi^V_{k_1 k_2} = \psi_{k_2} * \varphi_{k_1}$ - вариации вдоль строк и $\psi^D_{k_1 k_2} = \psi_{k_1} * \psi_{k_2}$ вариации вдоль диагонали. Каждая функция представляет собой произведение одномерной масштабирующей функции и соответствующей вейвлет-функции [3]:

$$\begin{aligned} \varphi_{j, k_1 k_2} &= 2^{j/2} * \varphi_{2^j * k_1 - m, 2^j * k_2 - n}, \psi^H_{j, k_1 k_2} = \\ &2^{j/2} * \psi^H_{2^j * k_1 - m, 2^j * k_2 - n}, \\ \psi^V_{j, k_1 k_2} &= 2^{j/2} * \psi^V_{2^j * k_1 - m, 2^j * k_2 - n}, \psi^D_{j, k_1 k_2} = \\ &2^{j/2} * \psi^D_{2^j * k_1 - m, 2^j * k_2 - n}. \end{aligned}$$

Причём выбирается $2^J = N = M$, так что $j = \overline{0, J-1}$, $n = \overline{0, 2 * J - 1}$ и $m = \overline{0, 2 * J - 1}$.

Дискретное вейвлет-преобразование функции $Y_{k_1 k_2}$ размерами $M \times N$ имеет вид [3]:

$$\begin{aligned} W_{\varphi_{j0, k_1 k_2}} &= \frac{1}{\sqrt{M * N}} \sum_{k_1=0}^N \sum_{k_2=0}^M Y_{k_1 k_2} \\ &* \varphi_{j0, k_1 k_2}, W_{\psi^H_{j, k_1 k_2}} = \\ &= \frac{1}{\sqrt{M * N}} \sum_{k_1=0}^N \sum_{k_2=0}^M Y_{k_1 k_2} \\ &* \psi^H_{j, k_1 k_2}, \\ W_{\psi^V_{j, k_1 k_2}} &= \frac{1}{\sqrt{M * N}} \sum_{k_1=0}^N \sum_{k_2=0}^M Y_{k_1 k_2} * \\ \psi^V_{j, k_1 k_2}, W_{\psi^D_{j, k_1 k_2}} &= \frac{1}{\sqrt{M * N}} \sum_{k_1=0}^N \sum_{k_2=0}^M Y_{k_1 k_2} * \\ &\psi^D_{j, k_1 k_2}, \end{aligned}$$

где j_0 – произвольный начальный масштаб и коэффициенты $W_{\varphi_{j_0,k_1k_2}}$ определяют приближение функции $Y_{k_1k_2}$ в масштабе j_0 . Коэффициенты $W_{\Psi^H_{j,k_1k_2}}$, $W_{\Psi^V_{j,k_1k_2}}$ и $W_{\Psi^D_{j,k_1k_2}}$ определяют горизонтальные, вертикальные и диагональные детали для масштабов $j > j_0$. Исходная функция $Y_{k_1k_2}$ может быть восстановлена с помощью обратного дискретного вейвлет-преобразования [3]:

$$Y_{k_1k_2} = \frac{1}{\sqrt{M \cdot N}} \sum_n \sum_m W_{\varphi_{j_0,k_1k_2}} * \varphi_{j_0,k_1k_2} + \frac{1}{\sqrt{M \cdot N}} \sum_n \sum_m W_{\Psi^H_{j,k_1k_2}} * \Psi^H_{j,k_1k_2} + \frac{1}{\sqrt{M \cdot N}} \sum_n \sum_m W_{\Psi^V_{j,k_1k_2}} * \Psi^V_{j,k_1k_2} + \frac{1}{\sqrt{M \cdot N}} \sum_n \sum_m W_{\Psi^D_{j,k_1k_2}} * \Psi^D_{j,k_1k_2}.$$

Суть процедуры сглаживания шума заключается в том, что коэффициенты деталей подвергаются пороговому ограничению с целью отделения высокочастотной шумовой составляющей от исходного неискажённого изображения [19, 20, 21].

Проблемами при дискретном вейвлет-преобразовании являются: достаточно сложный математический аппарат; зависит от типа материнского вейвлета, т.е. требуется априорная информация о функции полезного двумерного сигнала. Поэтому, необходимо подбирать определённый, наиболее приспособленный материнский вейвлет для каждого изображения.

Методы повышения резкости изображения

Фильтр Собеля

Фильтр Собеля [22] – дискретный дифференциальный оператор, применяемый для вычисления приближенного значения градиента яркости изображения. Он часто используется в алгоритмах выделения границ при обработке изображений.

Фильтр Собеля вычислим, так как он основан на свертках изображения с небольшими ядрами; следовательно, он аппроксимирует градиент со значительной погрешностью, но качество аппроксимации оказывается достаточным для многих практических приложений.

Маски фильтра Собеля задаются матрицами:

$$G_x = \frac{1}{4} \begin{pmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{pmatrix}, G_y = \frac{1}{4} \begin{pmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{pmatrix}.$$

Фильтр Собеля позволяет вычислить направление вектора градиента в плоскости для анализа изображения в виде угла φ между вектором градиента и направлением строк матрицы: $\varphi(x, y) = \arctg \left(\frac{G_y(x, y)}{G_x(x, y)} \right)$.

Одним из важнейших недостатков оператора Собеля является отсутствие у него полной вращательной симметрии.

Фильтр Превитта

Фильтр Превитта [22] использует одноименный оператор Превитта – метод выделения границ в обработке изображений, суть которого заключается в вычислении максимального отклика на множестве ядер свёртки для нахождения локальной ориентации границы в каждом пикселе.

Маски оператора Превитта задаются матрицами:

$$G_x = \frac{1}{3} \begin{pmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{pmatrix}, G_y = \frac{1}{3} \begin{pmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{pmatrix}.$$

Норма градиента оператора Превитта вычисляется аналогично оператору Собеля.

Фильтр Лапласа

Суть данного метода заключается в выборе дискретной формулировки второй производной и к последующему построению маски фильтра, основанной на данной формулировке. Согласно [25] простейшим изотропным оператором, основанным на производных, является лапласиан (оператор Лапласа), который в случае функции двух переменных $f(x, y)$ определяется как: $\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$.

Лапласиан считается линейным, так как производные любого порядка считаются таковыми. Данное выражение в дискретной форме: $\frac{\partial^2 f}{\partial x^2} = f(x+1, y) + f(x-1, y) - 2f(x, y)$, $\frac{\partial^2 f}{\partial y^2} = f(x, y+1) + f(x, y-1) - 2f(x, y)$.

Таким образом, дискретная формулировка двумерного лапласиана двух переменных будет: $\nabla^2 f(x, y) = f(x+1, y) + f(x-1, y) + f(x, y+1) + f(x, y-1) - 4f(x, y)$.

Это уравнение может быть реализовано с помощью маски фильтра: $\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, которая даёт изотропный результат для поворотов на углы, кратные 90° .

Диагональные направления также могут быть учтены в формуле дискретного лапласиана добавлением ещё двух членов – по одному для каждой диагонали. Маска фильтра, соответствующая такому новому определению, представлена: $\begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{bmatrix}$. Такая маска является изотропной для поворотов на углы, кратные 45° .

Следующие маски также часто используются на практике, они образованы из определения лапласиана, являющегося негативным: $\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$ и $\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$.

Применения этих масок даёт идентичный предыдущим маскам результат, но различие в знаке должно учитываться при комбинации – операцией сложения или вычитания – изображения, отфильтрованного лапласианом, с другим изображением.

Применение оператора Лапласа выделяет разрывы уровней яркости на изображении и подавляет области с малым изменением яркостей. Это приводит к получению изображения, содержащего сероватые линии на месте контуров и других разрывов, наложенные на тёмный фон без особенностей. Улучшение изображения происходит путём прибавления лапласиана-изображения к исходному.

Таким образом, обобщённый алгоритм применения лапласиана сводится к следующему: $g(x, y) = f(x, y) + c[\nabla^2 f(x, y)]$, где $f(x, y)$ и $g(x, y)$ – исходное и изображения с по-

вышенной резкостью. Константа $c = -1$, если использована маска фильтра лапласиана, и $c = 1$, если использованы «негативные» маски лапласиана.

Фильтр Канни

Метод Канни – многоступенчатый алгоритм, способный не только выделять контуры на изображениях, но и одновременно с этим устранять шум вблизи самих контуров.

Метод заключается в следующих этапах:

1) Размывание исходного изображения $g(m, n)$ с помощью фильтра Гаусса для уменьшения шума и подавления нежелательных деталей.

$$g(m, n) = G_0(m, n) \times f(m, n), \text{ где } G_0 = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{m^2+n^2}{2\sigma^2}\right).$$

2) Вычислить градиент $g(x, y)$ используя любую из дифференциальных операторов (Собеля, Превитта или др.) для получения:

$$M(m, n) = \sqrt{g_m^2(m, n) + g_n^2(m, n)}, \theta(m, n) = \tan^{-1}(g_n(m, n)/g_m(m, n)).$$

3) Определить порог для M :

$$M_T = \begin{cases} M(m, n), & \text{если } M(m, n) > T \\ 0, & \text{если } M(m, n) \leq T \end{cases}, \text{ где } M \text{ вы-}$$

брано таким образом, что все элементы края сохраняются, а шумовые составляющие подавляются.

4) Подавить не-максимумы, при этом отмечать только локальные максимумы как границы.

5) Ввести два порога – низкий τ_1 и высокий τ_2 , при которых все пиксели больше порога, скорее всего станут сильными краями, т.е. что между порогами – слабыми краями, а все что меньше нижнего обратятся в 0.

6) Определить какие из слабых краёв являются фактически сильными краями. Выполняем алгоритм отслеживания границ, при котором слабые края, связанные с сильными, становятся сильными, а слабые не связанные – удаляются. Таким образом устраняются разрывы в границах.

В результате получаем бинарное изображение без шумов и с замкнутыми отчетливыми контурами.

Морфологический анализ

Морфологические операторы [26] – фильтры, применяемые для морфологического анализа бинарных изображений. Морфологические операторы часто принимают двоичное изображение и структурирующий элемент в качестве входных данных и объединяют их с помощью операций над множествами (пересечение, объединение, включение, дополнение). Они обрабатывают объекты во входном изображении на основе характеристик его формы, которые закодированы в элементе структурирования. Морфологический анализ нашёл широкое применение в области векторизации изображений, оптического распознавания символов и в других задачах распознавания образов.

Обычно элемент структурирования имеет размер 3×3 и имеет начало координат в центральном пикселе. Он смещается по изображению и на каждом пикселе изображения его элементы сравниваются с набором базовых пикселей. Если два набора

элементов соответствуют условию, заданному оператором множества (например, если набор пикселей в элементе структурирования является подмножеством базовых пикселей изображения), пиксель под началом структурирующего элемента устанавливается в предварительно заданный элемент (0 или 1 для двоичных изображений). Поэтому морфологический оператор определяется его структурирующим элементом и применяемым оператором множества.

Основные операторы сужения и расширения часто используются для выбора или подавления признаков определённой формы, например, удаления шума из изображений или выбор объектов с определённым направлением.

Часто применяются составные морфологические операторы – открывающий и замыкающий фильтры. Первый состоит в последовательном применении сужающего и расширяющего операторов с одинаковым структурным элементом. Его морфологический эффект заключается в удалении малых изолированных частей фигуры. Применение сначала расширяющего, а затем сужающего оператора даёт замыкающий фильтр. Его эффект заключается в заполнении малых изолированных дырок фигуры. В обоих случаях, «малость» объекта определяется размером и формой структурного элемента операторов. Морфологические операторы также могут быть применены для удаления шума, но во многих задачах с этим лучше справляются пространственные фильтры.

Фильтрация в частотной области

Передаточная функция высокочастотного фильтра может быть получена из подобного низкочастотного фильтра при помощи соотношения: $H_{HP}(u, v) = 1 - H_{LP}(u, v)$ (1), где $H_{LP}(u, v)$ – передаточная функция соответствующего низкочастотного фильтра. Таким образом, частоты, ослабляемые низкочастотным фильтром, пропускаются высокочастотным фильтром, и наоборот.

Идеальные фильтры высоких частот

Двумерный идеальный фильтр высоких частот (идеальный ФВЧ) определяется формулой: $\tilde{H}_{u,v} = \begin{cases} 0, & \text{при } D_{u,v} \leq D_0 \\ 1, & \text{при } D_{u,v} > D_0 \end{cases}$, где D_0 – частота среза; $D_-(u, v)$ – расстояние от точки (u, v) до начала координат, т.е.: $D_{u,v} = \left[\left(u - \frac{P}{2}\right)^2 + \left(v - \frac{Q}{2}\right)^2 \right]^{1/2}$ (2), где P и Q – размеры расширенного изображения.

Исходя из выражения (1), связывающего фильтры высоких и низких частот, мы вправе ожидать, что идеальные ФВЧ обладают такими же свойствами в отношении звона, как и идеальные ФНЧ.

Фильтры высоких частот Баттерворта

Передаточная функция двумерного высокочастотного фильтра Баттерворта (ФВЧ Баттерворта) порядка n с частотой среза D_0 задается формулой: $H(u, v) = \frac{1}{1 + \left[\frac{D_0}{D(u,v)}\right]^{2n}}$, где расстояние $D(u,v)$ вычисляется согласно (2). Как и в случае с низкочастотными фильтрами, ФВЧ Баттерворта обладает более гладкой обработкой по сравнению с идеальным ФВЧ.

Гауссовы фильтры высоких частот

Передаточная функция гауссова фильтра высоких частот (ФВЧ Гаусса) с частотой среза, расположенной на расстоянии D_0 от центра частотного прямоугольника, задается формулой: $H(u, v) = 1 - e^{-D^2(u, v)/2D_0^2}$, где расстояние $D(u, v)$ вычисляется согласно (2).

Исследование фильтрации высокочастотной составляющей

Изображения несут в себе огромный объем данных, поэтому качество изображений напрямую

влияет на объем получаемой полезной информации об исследуемом объекте.

В рамках проекта разрабатывается многофункциональный ЭОП, для которого один из важнейших параметров – качество съёмки. В связи с этим необходимо определить эффективный метод выделения высокочастотной составляющей изображения.

В предыдущем разделе рассматривались различные методы фильтрации, далее будет проведено моделирование смазывания изображений и выделение их высокочастотных компонент. Для этого были выбраны три полутоновых изображения, которые можно видеть на рис. 4.

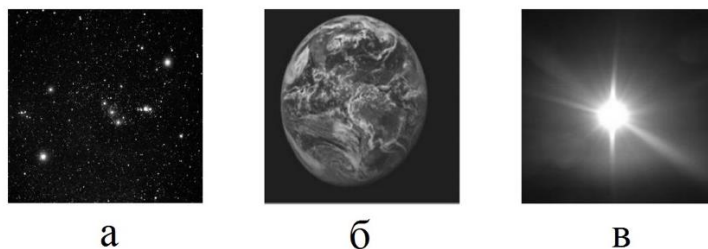


Рис. 3. – Обрабатываемые изображения.

В программной среде Matlab к каждому изображению были применены алгоритмы, моделирующие разного вида шумы – гауссов, пуассона, импульсный, мультипликативный и комбинированный, составленный из четырех предыдущих. Затем изображения были обработаны алгоритмом адаптивной фильтрации, описанным Андряковым А.А в [27].

В процессе обработки получаем набор изображений (рис. 8-15). На них показаны результаты воздействия шумов на выбранные изображения (рис. 4.). Полученные изображения получились сильно размытыми. Для решения этой проблемы необходимо дополнительно обработать изображения, а именно – выделить на них высокочастотные составляющие. Для этого воспользуемся следующими фильтрами: Собеля, Превитта, Канни, Лапласа, Идеальный ФВЧ, ФВЧ Баттерворта и ФВЧ Гаусса.

Результаты применения каждого фильтра приведены на рис. 8-15.

Сравнение фильтров осуществлялось по следующим критериям:

1) Время работы фильтра, измеряемое в секундах.

2) Мера структурного подобия SSIM: $SSIM = \left(\frac{\sigma_{uv}}{\sigma_u \sigma_v} \right) \left(\frac{2m_u m_v}{m_u^2 + m_v^2} \right) \left(\frac{2\sigma_u \sigma_v}{\sigma_u^2 + \sigma_v^2} \right)$, $\sigma_u = \sum_i \sum_j \left(\frac{u_{ij} - m_u}{(M-1)(N-1)} \right)^2$, $\sigma_v = \sum_i \sum_j \left(\frac{v_{ij} - m_v}{(M-1)(N-1)} \right)^2$, $\sigma_{uv} = \sum_i \sum_j \left(\frac{(u_{ij} - m_u)(v_{ij} - m_v)}{(M-1)(N-1)} \right)$, где u, v – исходное изображение и отфильтрованное изображение; i, j – номера пикселей исходного изображения и отфильтрованное изображение; M, N – раз-

меры изображения и отфильтрованного изображения; m_u, m_v – математическое ожидание исходного изображения и отфильтрованного изображения. Чем больше SSIM, тем больше мера подобия данных изображений. Величина SSIM принимает значения от 0 до 1. Для удобства будем использовать $RSSIM = 1 - SSIM$, таким образом, чем меньше RSSIM, тем больше мера схожести изображений.

Результаты сравнения сведены в гистограммы, соответствующие каждому типу шума, где приведены средние показатели критериев оценки изображения для каждого фильтра (рис. 5-7). На приведённых гистограммах можно отметить, что фильтры Собеля, Превитта, Канни и Лапласа имеют высокие показатели по первому критерию при всех видах шумов, что говорит о больших различиях исходного и обработанного изображений. Но они производят обработку быстрее, об этом нам говорят их низкие показатели по второму критерию. Оставшиеся фильтры высоких частот показывают хорошие результаты на каждом зашумленном изображении, как в степени подобия изображений, так и в быстродействии. Худшие результаты у идеального ФВЧ и ФВЧ Гаусса наблюдаются при обработке изображений с шумом Пуассона. Из всего перечня фильтров выделяется ФВЧ Баттерворта, который показывает приблизительно одинаково хорошие результаты, вне зависимости от типа зашумления.

Исходя из результатов моделирования, можно заключить, что наиболее эффективно с задачей выделения высокочастотной составляющей справляются методы частотной фильтрации, наилучшие результаты показал ФВЧ Баттерворта.

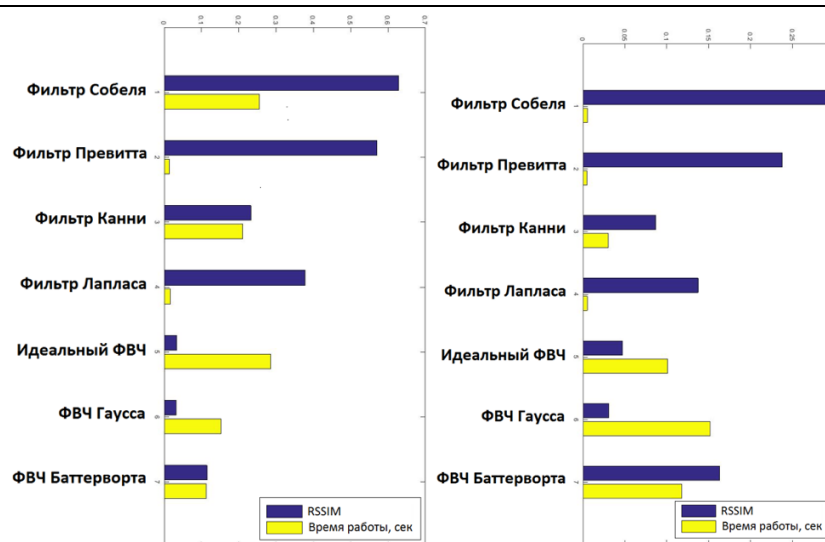


Рис. 4. – Гистограмма количественных оценок качества фильтрации изображений, зашумлённых гауссовым шумом (слева) и зашумлённых шумом Пуассона (справа)

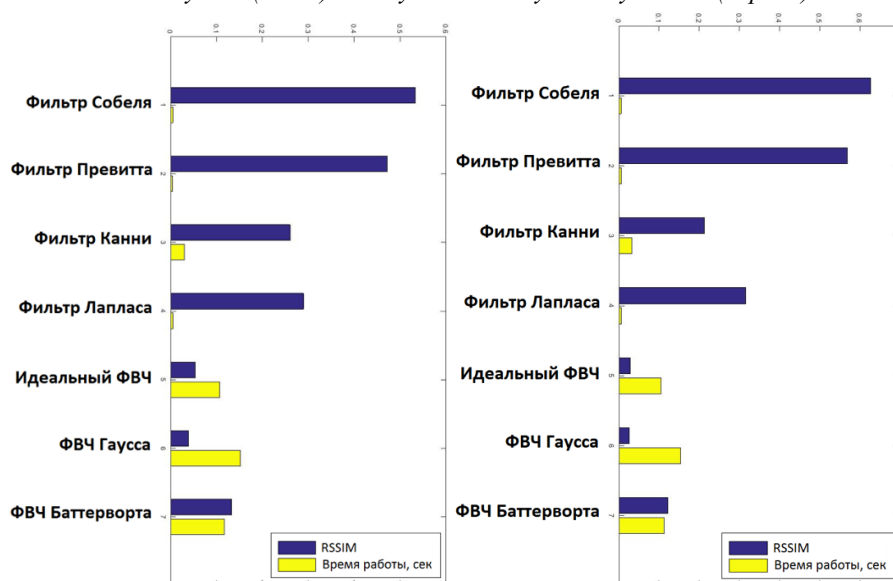


Рис. 6. – Гистограмма количественных оценок качества фильтрации изображений, зашумлённых импульсным шумом (справа) и зашумлённых мультипликативным шумом (слева).



Рис. 7. – Гистограмма количественных оценок качества фильтрации изображений, зашумлённых комбинированным шумом.

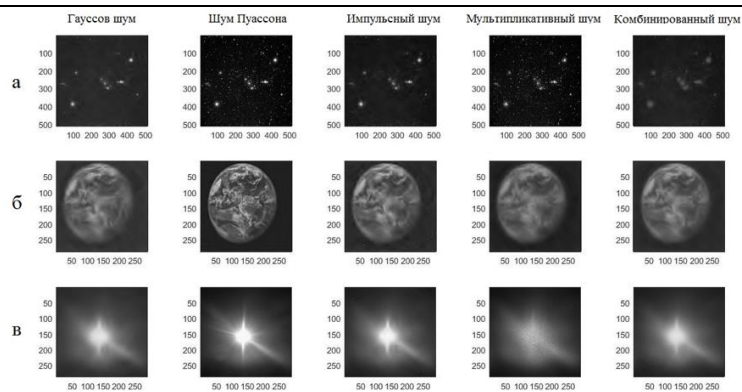


Рис. 8. – Результат применения адаптивной фильтрации.

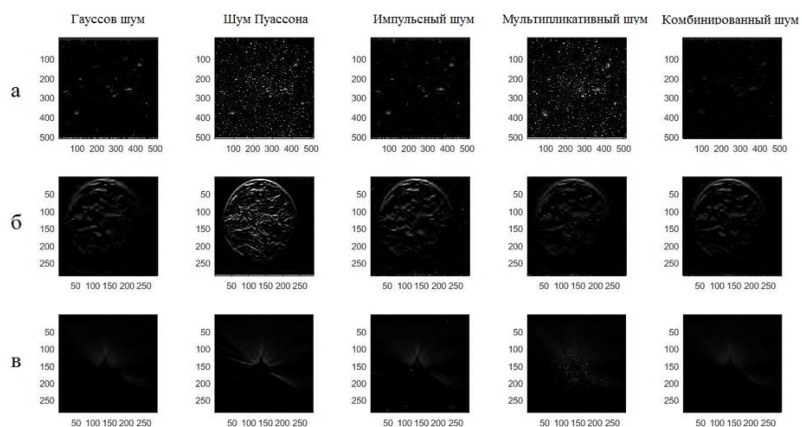


Рис. 9. – Результат применения фильтра Собеля.

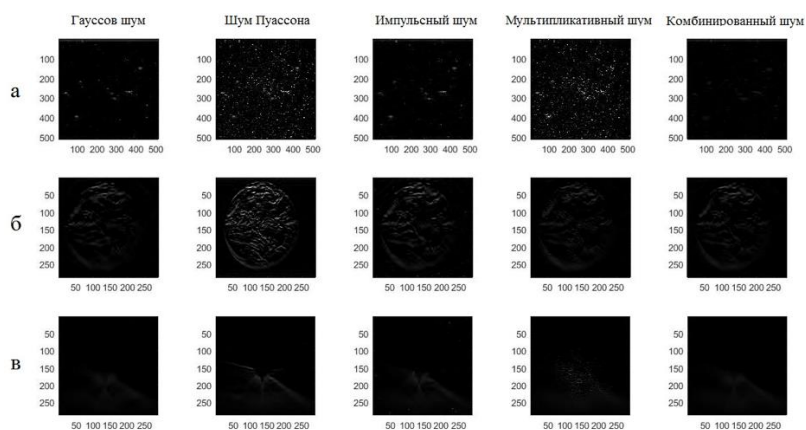


Рис. 10. – Результат применения фильтра Превитта.

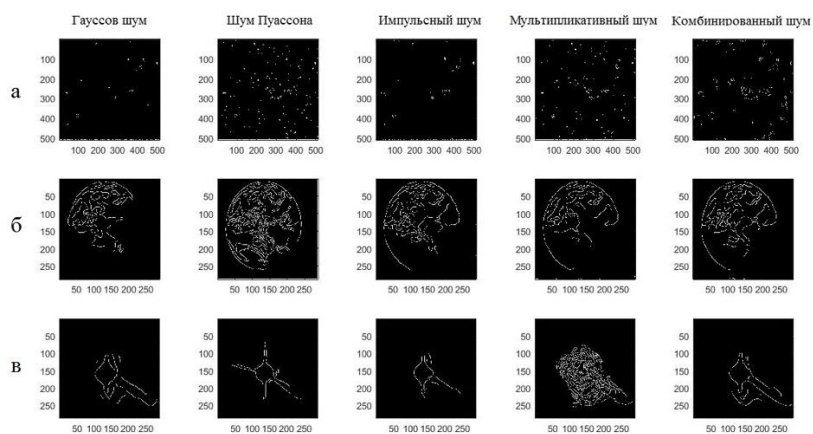


Рис. 11. – Результат применения фильтра Канни.

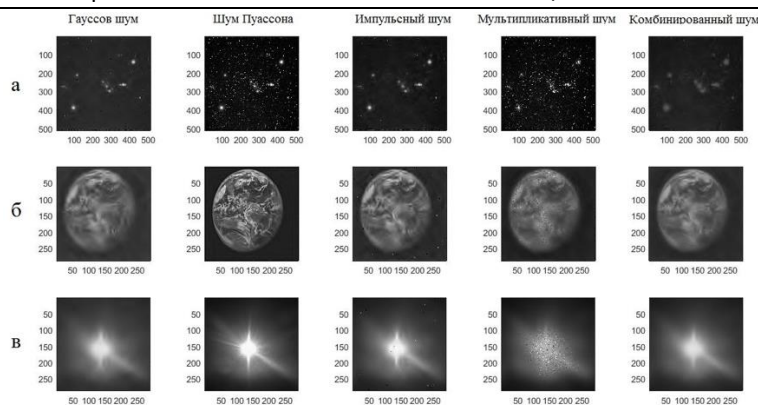


Рис. 12. – Результат применения фильтра Лапласа.

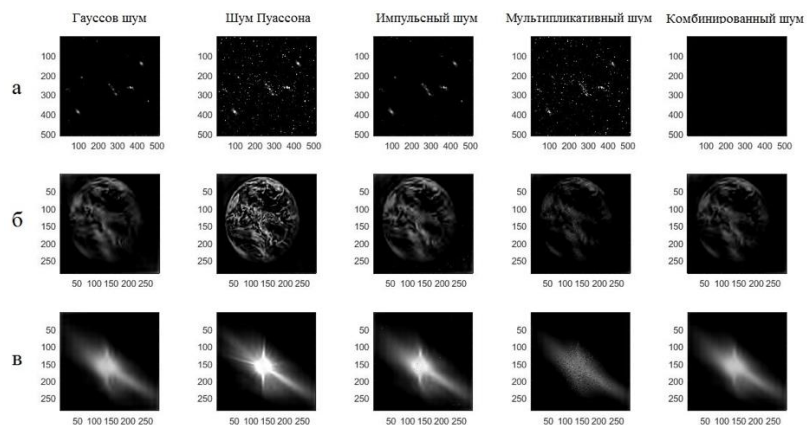


Рис. 13. – Результат применения идеального ФВЧ.

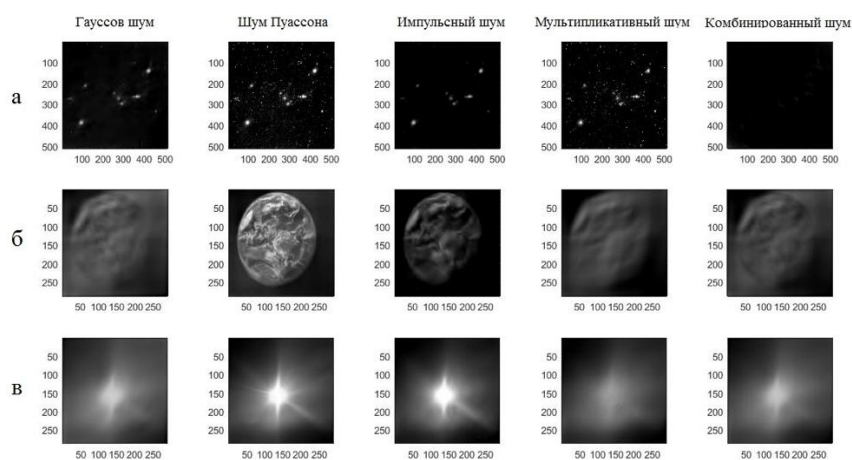


Рис. 14. – Результат применения ФВЧ Баттерворта.

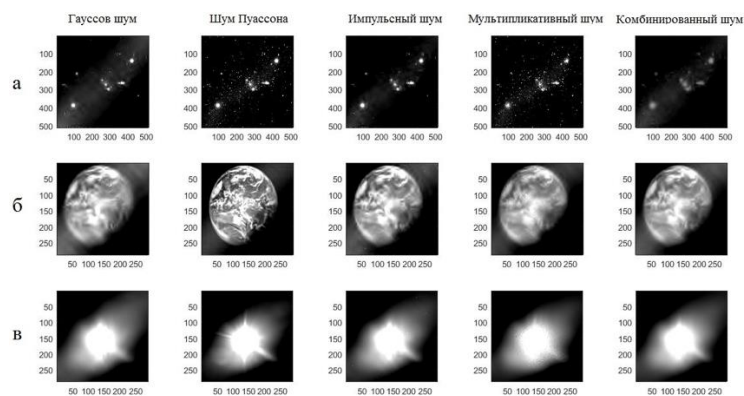


Рис. 15. – Результат применения ФВЧ Гаусса.

Заключение

В работе исследованы методы фильтрации высокочастотной составляющей изображения. По результатам моделирования установлено, что наиболее эффективно с этой задачей справляются фильтр высоких частот: фильтр Баттерворта, способный быстро выполнять обработку, а после его применения изображение сохраняет большую информативную составляющую. Также приемлемые результаты показали идеальный и Гауссов высокочастотные фильтры, они лишь немного уступают в быстродействии и сохранении информативности элементов изображения.

Разностные фильтры оказались менее эффективны, показав наибольшее время обработки, а также после их применения может теряться большой объем полезной информации. Работа выполнена при финансовой поддержке гранта Российского научного фонда, Санкт-Петербургского научного фонда (соглашение № 22-29-20186 и № 03/2022).

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