# ФИЗИКА-МАТЕМАТИКА ҒЫЛЫМДАРЫ
# ФИЗИКО-МАТЕМАТИЧЕСКИЕ НАУКИ
# PHYSICAL AND MATHEMATICAL SCIENCES

## THE STUDY OF THE EFFECTIVITY OF LEARNING PHYSICS THROUGH DISTANCE EDUCATION AND AUTOMATIC DIGITAL RESPONSE ON SECONDARY STUDENTS IN KAZAKHSTAN

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**Аннотация.** Дистанционное обучение становиться все популярней с каждым днем, но также очевидно, что оно нуждается в более глубоком анализе. Данная статья является анализом дистанционного обучения в попытке ответить на вопрос: Есть ли значительная разница между традиционным и дистанционным образованием? Также целью работы является подготовка основы и критерий для анализа посредством разбора аналогичных кейсов, с последующим изучения эффективности обучения физике с помощью дистанционного обучения для старших классов в Казахстане.

**Ключевые слова:** онлайн-обучение, дистанционное обучение, технологии, обучение, образование, инклюзивное образование.

**Аңдатпа.** Қашықтықтан оқыту әр күн сайын көбірек танымал болып келеді, сондықтан қазіргі кезде тереңірек талдау қажеттілік туып жатыр. Бұл мақала қашықтықтан оқытуды талдау барысында осы сұраққа жауап береді: дәстүрлі және қашықтықтан білім беру арасындағы айтарлықтай айырмашылық бар ма? Сондай-ақ, жұмыстың мақсаты - ұқсас тақырыптық зерттеулерді талдау арқылы талдаудың негізі мен критерийін дайындау, кейіннен Қазақстандағы жоғарғы сыныптар үшін қашықтықтан оқыту арқылы физиканы оқытудың тиімділігін зерттеу.

**Түйінді сөздер:** онлайн оқыту, қашықтықтан оқыту, технология, оқыту, білім, инклюзивті білім.

**Abstract.** The distance learning's popularity is on the rise with each day, but it is evident that such an educational phenomenon requires more thorough research. The article by Timerlan Kaiyrmagambetov, is an analysis of distance learning in an attempt to answer the question: Is there a significant difference between traditional and distance education? In addition, the aim of the work is to prepare the framework and the criterion for analysis by comparing similar case studies, followed by looking at the effectiveness of teaching physics through distance learning for the Secondary school students in Kazakhstan.

**Key words:** online learning, distance learning, technology, learning, education, inclusive education.

**Introduction.** Distance education, in general, is educational process in which communication between instructor and learner is separated in time and space. The reason of distance education varies from person to person and include personal limitations or work, family related

responsibilities. It worth noticing that such an isolated approach of education requires a thorough institutional support, custom-trained tutors and study center networks (Krämer 2015).

The number of Distance education and online courses, in particular, being offered in university and college programs is on a rise each day. According to The Online Learning Consortium, formerly called the Sloan Consortium, is an institutional and professional leadership organization dedicated to integrating online education into the mainstream of higher education, 49% of institutions provided online learning courses in 2003 and 56% in 2005 as a part of their strategic plans for future development (Allen and Seaman 2005).

The following concepts are going to be analyzed in this article:

1) What are the criteria to analyze differences between distance and traditional face-to-face education?

2) How effective is distance learning for Secondary School students?

3) Potential benefits, Advantages and Disadvantages of Online Distance Education.

The baseline for research will be formed by comparative study of similar case but on Master's Level students. The results will be discussed, so foundation for further research of learning effectivity analysis of Physics through distance education and automatic digital response on secondary students in Republic of Kazakhstan will be established. Secondary students will experience the main factors of previous study, similar pre-conditions and conditions during the research will be formed to possible extent. It is worth noticing that engaging students in fully independent Physics learning does not seem feasible, sothe primary difference between following research and previous studies is that high school students will experience blended learning which means traditional face-to-face learning process will be continued while online distance education will be added supplementary to distinguish the potential improvement in learning. By comparing with previous stud prediction for the potential advantages and drawbacks of online distance education will be proposed.

**Methodology.** The current study framework was formed by the following research of determining the difference in competence gains between online course and face-to-face classroom the article uses the study of Master's level students in an online course in Cognition, Learning and Assessment and compared it with the performance of students in a face-to-face classroom setting of the same course (Ferguson and Tryjankowski 2009).

Recognizing challenges from other studies, the following conditions were implied before the course started, making the study of performance as smooth as possible.

• Learners possess the self-motivation and responsibility to learn at distance

• Learners have skills and access to the minimal technology used in the course

- Supplementary materials as outline course objectives, concepts, learning outcomes in clear summarized form were presented to the learners

- Library resources with virtual library are available through World Wide Web

- Assignment deadlines and feedback are agreed between instructors and learners

- The same instructor will design and lecture online and face-to-face courses

- Analysis of performance was up to these assessments:

- Two assignments were identical to the both groups and the grading factors were the same. First assignment was Changed Behavior Report which is altering and designing plan to achieve their goal with chosen personal behavior. Second was Classroom Management Design project which is designing the discipline framework in the classroom.

- Common final exam was conducted on campus and was a combination of multiple-choice, short answer and essay questions.
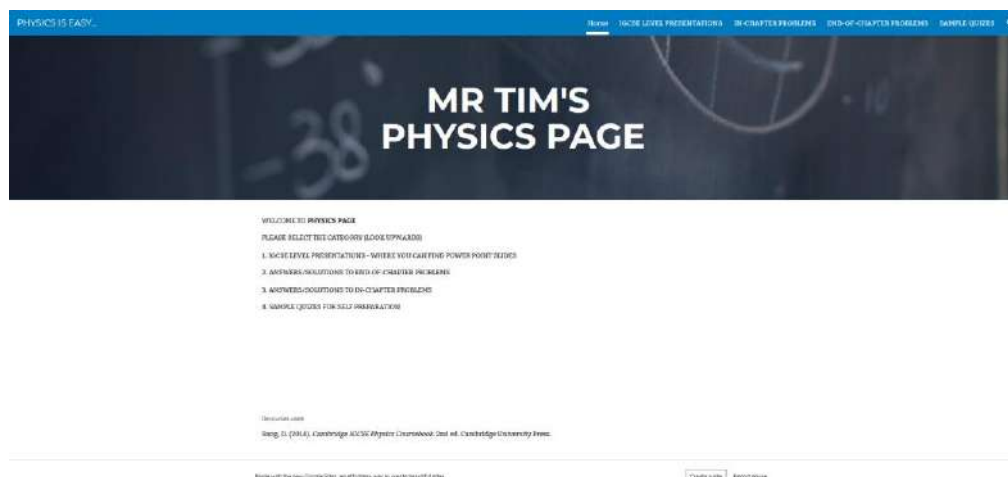
All the data of online distance students (N=44) and face-to-face students(N=26) were collected and analyzed for 2 two years. Traditional style learners met once per week for 2.5 hours, while distance learners did not meet at all until the final exam.

Final exam scores, GRE scores and grades were analyzed by Statistical Package for Social Sciences (SPSS). Anonymity was provided by assigning random numbers. Academic ability was ensured by using t-test for independent samples. Analysis of covariance (ANCOVA) with dependent variables as the scores from two assignments and the final exam score. Covariate function was GRE. The search for significant difference in the means between face-to-face and online learners' results was run by ANCOVA.

The research of effectivity analysis of learning Physics through distance education and automatic digital response on secondary students in Kazakhstan.

Masters students case analysis provided with the following condition framework to facilitate learning process for:

- Learners have skills and access to the minimal technology used in the course

- Supplementary materials as outline course objectives, concepts, learning outcomes in clear summarized form were presented to the learners

- Assignment deadlines and feedback are agreed between instructors and learners

- The same instructor will design and lecture online and face-to-face courses

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- Analysis of performance was up to these assessments:

- Homework(HW)

- Continual Assessment(CA) = QUIZEs (Individual tests) + End-of-Chapter problems(group tests)

- Examinations(EXAM)

The website (Kaiyrmagambetov 2019) is designed by author of research paper to provide distance education materials mentioned above. The website (Figure 1) has cross-platform functionality, meaning available on PC, Laptops, mobile devices and tablets, and is categorized according the following sections:

- IGCSE LEVEL PRESENTATIONS– Lecture slides in Power Point format highlighting main point of the LECTURE with 2-3 minute videos and problem set

- IN-CHAPTER PROBLEMS – Solution manuals for students in order to improve their study skills and independent analysis of their HWS/QUIZES

- END-OF-CHAPTER PROBLEMS – Solution manuals for students in order to improve their study skills and independent analysis of their GROUP TEST

- SAMPLE QUIZES – Self Preparation tests with feedback for independent analysis of students' level.

**Results**. For the case of determining the difference in competence gains between online course and face-to-face classroom the article uses the study of Master's level students in an online course in Cognition, Learning and Assessment and compared it with the performance of students in a face-to-face classroom setting of the same course (Ferguson and Tryjankowski 2009).

Table 1 and 2 analysis demonstrates us Test scores, GRE scores, Changed Behavior Report and Classroom Management Design. Regarding Final exam scores, face-to-face got significantly more points than the other group ($F=7.25$, $p<.01$). Difference was also obtained in Classroom

Management Design (F =7.49, p < .01). However, no significant difference was obtained between groups in Changed Behavior Report.

Table 1. Statistics description(Ferguson and Tryjankowski 2009).

| | Course type | N | Mean | Std. deviation | Std. error of mean |
|---|---|---|---|---|---|
| Test scores | Online | 55 | 22.5 | 3.16 | .426 |
| | Face to face | 33 | 24.5 | 2.68 | .466 |
| GRE scores | Online | 44 | 1338 | 224 | 33.8 |
| | Face to face | 26 | 1282 | 187 | 36.8 |
| Changed Behaviour Report | Online | 55 | 14.49 | .573 | .077 |
| | Face to face | 33 | 14.33 | .540 | .152 |
| Classroom Management Design | Online | 55 | 14.5 | .716 | .096 |
| | Face to face | 33 | 14.9 | .291 | .121 |

Table 2. Statistics description with covariance (Ferguson and Tryjankowski 2009).

| | F | Significance | N |
|---|---|---|---|
| Test scores | 7.25 | < .01 | 69 |
| Changed Behaviour Report | 1.39 | | 69 |
| Classroom Management Design | 7.49 | < .01 | 69 |

*GRE as the covariate.

Regarding, the research of effectivity analysis of learning Physics through distance education and automatic digital response on secondary students in Kazakhstan, it is important to mention that the current study has some minor differences from the previous of Master level students by Ferguson and Tryjankowski. Firstly, to ensure academic ability of the students, all of them passed Cambridge Checkpoint exam. Secondly, final exam scores, continual assessment and homeworkgrades were analyzed by Minitab (General-purpose statistical software package designed for easy **interactive** use). Anonymity was provided by assigning random numbers to student. Thirdly, ANOVA test was used instead of ANCOVA due to absence of GRE or any pre-test results that couldbe used as covariate function. The search for significant difference in the means between face-to-face and online learners' results was run by ANOVA with Continual Assessment, Homework and Final exam scores as dependent variables were used.

The research results demonstratedbelow introduce the idea of distance education to be alternative or additional learning practice potentially. It is worth noticing that Term 2 was lectured in traditional face-to-face manner, unlike Term 3 that was taught in blended learning style with the involvement of distance online educational methods.

Table 3 clearly demonstrates interesting trends in online vs traditional comparison. In the table, N is a number of students, Mean is an average value in the group, StDev is a standard deviation in the group,SE is standard error of the Mean, Max and Min are maximum and minimum

values. The mean averages are clearly higher for traditional style over blended in continual assessment and exam categories. On the contrary, only homework category demonstrated grades for online learning to be higher than traditional one.

Table 3. Statistics description for every assignment

|                    | N  | Mean  | StDev | SE Mean | Min   | Max    |
|--------------------|----|-------|-------|---------|-------|--------|
| HW (Traditional)   | 23 | 76.19 | 14.83 | 3.09    | 41.38 | 95.00  |
| HW (Online aided)  | 23 | 80.22 | 22.38 | 4.67    | 35.00 | 100.00 |
| CA (Traditional)   | 23 | 81.36 | 11.23 | 2.34    | 52.50 | 97.00  |
| CA (Online aided)  | 23 | 77.86 | 14.53 | 3.03    | 44.00 | 96.60  |
| EXAM (Traditional) | 23 | 49.99 | 25.74 | 5.37    | 3.00  | 97.00  |
| EXAM (Online aided) | 23 | 49.68 | 20.84 | 4.34    | 20.00 | 88.00  |

In the Table 3, N is a number of students, F is a F-ratio value, P is a p value, **α** is a Significance level. The null hypothesis for ANOVA analysis is that "Online students would perform on the same level as face-to-face students". The P-values for 3 assignments are bigger that 0.05 meaning that there is not enough evidence to reject the null hypothesis that the population means are all equal among the assignments.

*Table 4. ANOVA Statistics description for every assignment*

|                                    | N  | F    | P    | α    |
|------------------------------------|----|------|------|------|
| CA (Traditional vs Online aided)   | 23 | 0.83 | 0.37 | 0.05 |
| HW (Traditional vs Online aided)   | 23 | 0.52 | 0.48 | 0.05 |
| EXAM (Traditional vs Online aided) | 23 | 0.00 | 0.97 | 0.05 |

Table 4 sums up all the data in overall grades for traditional and online aided groups, respectively. It is worth mentioning that overall traditional score was higher overall as well as P-value being greater that significance value (0.05) supports the idea that there is not enough evidence to reject the null hypothesis that the population means are all equal overall amongst two groups of learners.

*Table 5. ANOVA Statistics description for every assignment*

| Variable          | N     | Mean  | StDev | SE Mean | Min   | Max   | F    | P    |
|-------------------|-------|-------|-------|---------|-------|-------|------|------|
| OVERALL (TRAD)    | 23.00 | 72.40 | 13.74 | 2.86    | 43.93 | 97.15 | 0.03 | 0.86 |
| OVERALL (ONL)     | 23.00 | 71.68 | 13.91 | 2.90    | 44.75 | 93.88 |      |      |

**Conclusion.** For the case of determining the difference in competence gains between online course and face-to-face classroom the article uses the study of Master's level students in an online course in Cognition, Learning and Assessment and compared it with the performance of students in a face-to-face classroom setting of the same course (Ferguson and Tryjankowski 2009), the results did not support the hypothesis that online students would perform on the same level as face-to-face

students. It is clear that further studies are required to establish the possible reasons for such results. It worth noticing that successful online learners require self-motivation and self-discipline with basic technological skills as computer, Internet, search and navigation as well as digital literacy.

In addition, designing an online distance course may be a challenge for the most professors. The study on online course designing challenges was performed for "Asia-Pacific Network for Sustainable Forest Management and Rehabilitation" programby the University of British Columbia in collaboration with universities from Canada, China, Malaysia, the Philippines and Australia.The survey was performed amongst professors responsible for creating such a transnational online distance education course. Table 4 clearly demonstrates that online distance education needs more time to develop itself, so the advantages of such a learning technique will prevail. Rating scale was from 1 to 5, Strongly disagree to Strongly agree respectively. It is evident that professors needed more experience in developing, teaching and learning in an online environment by analyzing scores 2.3,2.0 and 2.3 respectively (Crowley, Chen & Cerver, 2018)

Table 6. Leading Professors' Experience with Online Course Development and Delivery

|   | Survey Statement | Average |
|---|---|---|
| 1 | I have background in developing online courses prior to the APF Net project | 2.3 |
| 2 | I have background in teaching online courses prior to the APF Net project. | 2.0 |
| 3 | I have experience learning in online courses prior to the APF Net project. | 2.3 |
| 4 | I have experience working with an instructional designer before. | 1.7 |

Regarding, the research of effectivity analysis of learning Physics through distance education and automatic digital response on secondary students in Kazakhstan, the author focuses on the hypothesis that "Online students would perform on the same level as face-to-face students". The study doesn't demonstrate enough evidence to reject the hypothesis but it is crucial to understand that the research needs improvement in a lot of factors, such as, taught course materials are different for each term, given exams and assignment differ from each other in each term, time spent for research needs to be extended.

By comparing only overall averages for terms, the score for traditional course is slightly higher than for online aided one. Difference may arise due to the fact that successful online learners require self-motivation and self-discipline with basic technological literacy such as navigation of computer and the internet. It is essential to take note that high school students may lack all the range of the skills starting from motivation, discipline to basic digital literacy skills.

On the other hand, research outcome provides us with a potentially alternativeteaching method to traditional taught classroom as the difference obtained is not statistically significant. The study gives light on the advantages of online distance education as a better access to the course, especially, for those who is not able to attend traditional face-to-face classes due to physical limitations, financial and socio-economic factors etc. In addition, it enables students to become more self-aware of study habits and manage their time adequately. Furthermore, distance education may result in more innovative ways of teaching and more efficient assessment for the instructors.

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## МАССА И МОЩНОСТЬ ИЗЛУЧЕНИЯ НЕБЕСНЫХ ТЕЛ

**В.Л. СКУРЫДИН**

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**Аңдатпа.** Аспан денелерін жылытудың ядролық теориясына күмән келтіре отырып, автор планеталарды қыздыру осы денелердің (массивтердің) планетааралық кеңістікпен (өріспен) өзара әрекеттесуімен байланысты деп санайды. Осылайша Күн мен жұлдыздар қозған өрістен энергия алады, содан