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INTERDISCIPLINARY CONNECTIONS AND THEIR INFLUENCE ON MATHEMATICAL EDUCATION OF STUDENTS

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Key words: Interdisciplinary connections, Integral Error Functions, IEF method.

Abbreviations: IEF – Integral Error Function; FTB, STB, TTB – are first, second and third type boundary problems; ES – experimental study stage; CS – control study stage.

Abstract. Mathematically and statistically it was proved that, interdisciplinary connections help educators to develop new, effective methods that positively effect on mathematical achievement of students. Moreover during the pedagogical experiment it was shown that new developed methods are easier and more understandable. During the data analyzes SPSS (Statistical Packet for Social Sciences) computer program was used.

Introduction. Interdisciplinary connection ensures efficient formation of scientific concepts and theories studied in depth assimilation. It facilitates the integration of science, the development of links between the fields of knowledge defining the location of discipline in the sciences. Interdisciplinary connection in its development has objective reasons.

First base - the rule of comprehensiveness of training. For a comprehensive knowledge of the subject, it is necessary to capture, examine all aspects of its connections. The same phenomena of the objective world have described by different sciences from different sides. Therefore, anticipating the process of combining the different properties of the object in the minds of students in teaching should be established between academic disciplines.

Second base - constantly ongoing process of integration of the sciences. Quality of education largely depends on the interaction between the fields of knowledge, and therefore need to understand the place of their discipline in the sciences and in the relationship that exists between science and practice.

Interdisciplinary connection is a main part of the professional training areas. Therefore, in the range of works on vocational and educational training of future school teachers, university professors of mathematics to include the implementation of a focused interdisciplinary connections. It should be separate and isolate also featured links, like composition, method, focus. This helps to establish the relationship between all forms of methodological training, increases the efficiency of professional and pedagogical orientation training. Training will be full and satisfy the modern requirements, if implemented multifaceted relationship with general subjects and special profiling. Obviously in this case, that goal will be achieved only when installed in the right-object logical connection - a slender sequence of presentation, the gradual deepening of the synthesis and material, the disclosure of the prospects of the theory and its application in practice. Outlook for education is crucial to an effective demonstration of mathematical concepts in other sciences. Differential equations are so useful, that their concepts, formulas, methods, algorithms can be used by engineers, technicians, chemists, biologists, economists, and representatives of other sciences, not to mention the mechanics and physics. This gives the teacher the opportunity to discover opportunities for applying mathematics and illustrate its application in other disciplines and practices.

Tasks that require the use of knowledge from related disciplines or applied with a didactic purpose in teaching other subjects are considered, usually problems with cross-curricular content. Many problems in science lead to a differential equation, the solution of which can improve math skills, and intuition, that is, possess a sufficiently high level of mathematical culture.

Relationship of differential equations with other objects can fully reveal the essence of these types of interdisciplinary connections, describe each of them, it is appropriate to use the objective laws of the optimal implementation and impact through it to expand and deepen the worldviews of students.

Interdisciplinary connection - is not only didactic conditions and means of improving the efficiency of learning and skills, but also the general pedagogical means of an integrated approach to the education of students in the learning process.

In this paper it was tried to show the use of interdisciplinary connection on the example of Mathematical Physics course. Using Integral Error Function a new effective method was developed that positively effects on mathematical achievement of students.

The study was carried out at Suleyman Demirel University for Master degree students during Control Study stage and Experimental Study stage.

On the base of results, obtained by S.N. Kharin, where insolvability of Heat equations by Picard's iteration method, which were reduced to system of integral equations, was shown due to the singularity of integrals. It was shown that new method enables us to solve heat equations in easier and quite precise way. Moreover when traditional Fourier and Laplace transforms used to solve Heat equations some difficulties arise concerning finding inverse transforms.

There are 3 so called Ψ tests, each assigned for Homogeneous Heat problems with first, second and third type boundary conditions. Each test consist of same type, three problems, which were firstly done on 3-rd grade students during the special course "special methods of solving heat problems". Cronbach's alfa, mean, item mean and standard deviation were calculated.

The study of influence of IEF method on improvement of Master Degree students in solving heat problems was divided into two stages control study, and experimental study stages. In the first stage students were instructed traditional HP method where students learnt how to solve homogeneous, nonhomogeneous Heat problems with first, second and third type boundary conditions. After learning method of solution of certain boundary value problem Ψ tests were taken to collect the data and compare results of same tests done during the second stage where IEF method was instructed.

Data analyses of Ψ -1 Test. The pre- and post-test results of Ψ tests were compared and the results were analyzed by SPSS program. The means and standard deviations of the pre- and post-tests are shown in tables and can be observed on the graphs. Tests were initially applied for 3-rd grade students in order to calculate their Cronbach's alfa coefficients.

Ψ -1 test was firstly applied for 3-rd grade students and its Cronbach's alfa was calculated, additionally, information concerned with average, standard deviation and item mean are shown in the table.

Table 1 – Ψ -1 test for 3-rd grade university students

Subjects	Type of Instruction	N	Type of the test	Cronbach's alfa	Mean	Item Mean	Std. Deviation
3-rd grade students	IEF method	30	Ψ -1	0,913	11,4667	3,822	2,73840

The average results of 3-rd grade students during the ES stage are comparatively high because heat problems, included into the test, did not contain derivatives on the boundaries. Since no extra calculations were required in FTB conditions the test was reasonably easier than other tests.

Table 2 – Ψ -1 test for master degree students

Stages of the study	Type of Instruction	Subjects	N	Type of the test	Mean	Item mean	Std. Deviation
CS	HP method	Master degree students	20	Pre Test (Ψ -1)	10,200	3,4	2,14476
ES	IEF method		20	Post Test (Ψ -1)	12,900	4,3	1,74416

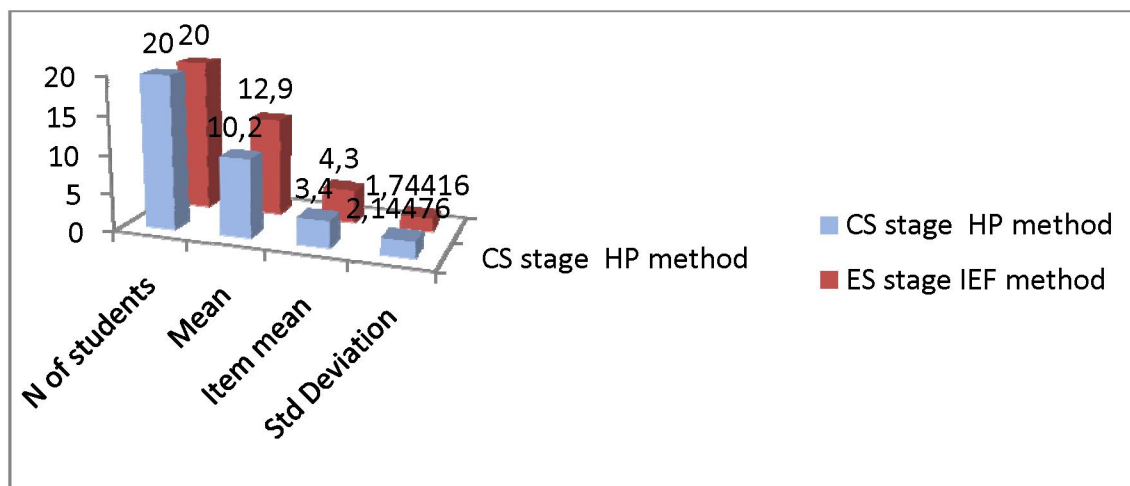


Figure 1 – Results of the Ψ -1 test during CS & ES stages

Pre and Post Ψ -1 tests results are shown on the figure and in the table. One can observe that during the CS stage students showed lower performance in solving problems than during the ES stage where IEF method was instructed. The reason is that in CS stage more complicated mathematical techniques are used, it is necessary to apply correctly Heat Potentials and jump theorem, make substitutions and calculate the integral.

It is remarkable that even though problems were comparatively easier than in other tests, the mean and item mean for 3-rd grade students that received IEF instruction are higher than mean and item mean of Master Degree students that received HP method instruction during the CS stage. But it should be noticed that the number of students was different and education level was also different.

Data analyses of Ψ -2 Test. Ψ -2 test was firstly prepared for 3-rd grade students and applied after IEF method was instructed. Cronbach's alfa, average, standard deviation and item mean of the test were calculated which are shown in the table.

Table 3 – Ψ -2 test for 3-rd grade university students

Subjects	Type of Instruction	N	Type of the test	Cronbach's alfa	Mean	Item Mean	Std. Deviation
3-rd grade students	IEF method	30	Ψ -2	0,853	11,1000	3,700	2,23375

The results of the test for 3-rd grade students are a bit lower this time because in the second type boundary value problem it is required to take derivative of the IEF.

Table 4 – Ψ -2 test for master degree students

Stages of the study	Type of Instruction	Subjects	N	Type of the test	Mean	Item mean	Std. Deviation
CS	HP method	Master degree students	20	Pre Test (Ψ -2)	9,950	3,317	2,32775
ES	IEF method		20	Post Test (Ψ -2)	12,350	4,117	1,74416

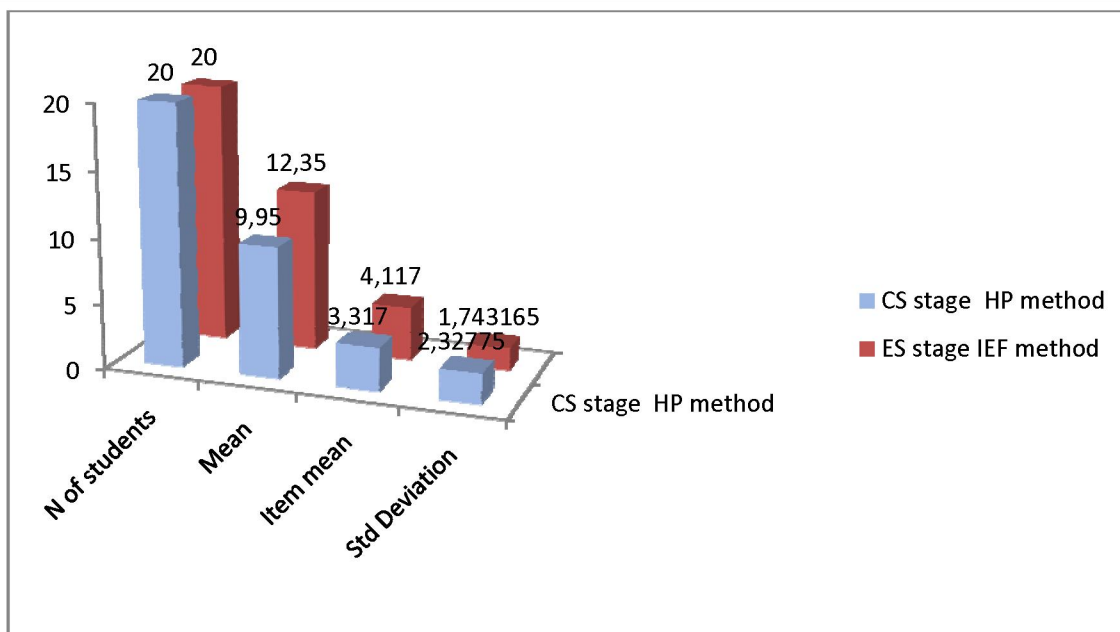


Figure 2 – Results of the Ψ-2 test during CS & ES stages

It is possible to observe that it is more difficult to calculate and apply Heat Potentials to solve second boundary value problems for students during CS stage.

Data analyses of Ψ-3 Test. As in other tests it is possible to see in the table Cronbach’s alfa, average, standard deviation and item mean of Ψ-3 test that was applied for 3-rd grade students.

Table 5 – Ψ-3 test for 3-rd grade university students

Subjects	Type of Instruction	N	Type of the test	Cronbach’s alfa	Mean	Item Mean	Std. Deviation
3-rd grade students	IEF method	30	Ψ-3	0,847	10,7333	3,578	2,42022

The test was applied to Master degree students during the CS stage where HP method was instructed and during ES stage where IEF method was instructed. The mean and item mean of the test is affected due to the mathematical apparatus that is required to solve Heat Problem with TTB conditions. It is necessary to be capable to predict power of t in the IEF solution.

Table 6 – Ψ-3 test for master degree students

Stages of the study	Type of Instruction	Subjects	N	Type of the test	Mean	Item mean	Std. Deviation
CS	HP method	Master degree students	20	Pre Test (Ψ-3)	9,7000	3,233	2,47301
ES	IEF method		20	Post Test (Ψ-3)	12,000	4,000	1,68585

Ψ-3 test during CS & ES stages.

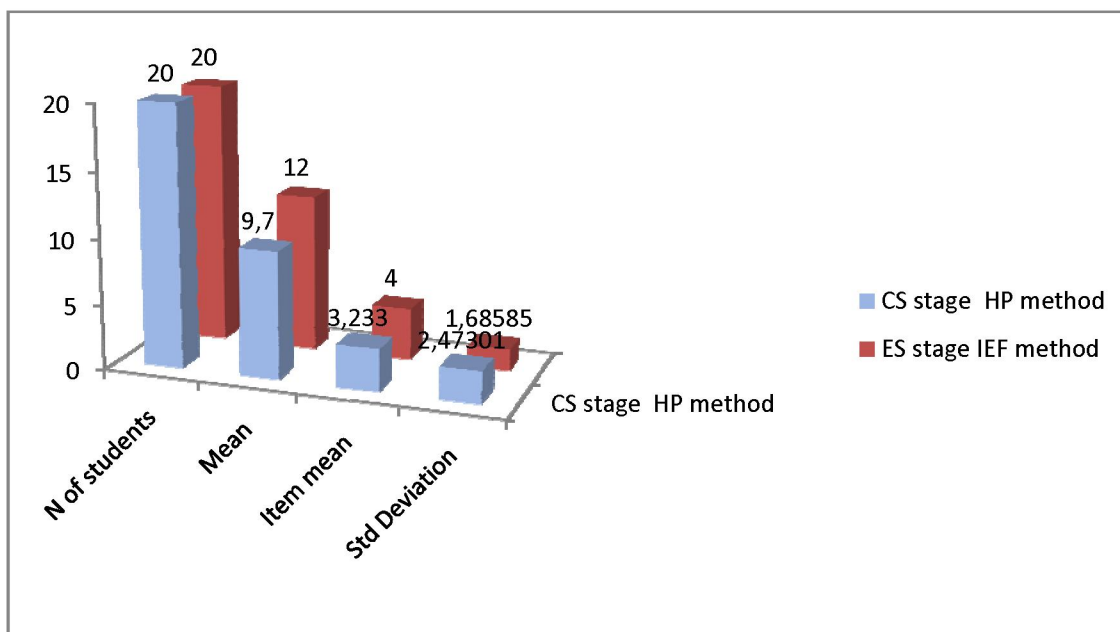


Figure 4 – Results of the Ψ-3 test during CS & ES stages

Above data allows us to say that Heat Problems with TTB conditions are harder than preceding problems. Neither the less IEF method anyway shows positive and positively effects on improvement of problem solving.

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ПӘНАРАЛЫҚ БАЙЛАНЫСТАРДЫҢ СТУДЕНТТЕРДІҢ ОҚУ ҮЛГЕРІМІНЕ ӘСЕРІ

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Аннотация. Пәнаралық байланыстардың жаңа есеп шығару әдістерін дамытуға мүмкіндік бере отырып, студенттердің үлгеріміне оң әсерін тигізетінін математикалық және статистикалық тұрғыдан дәлелденген. Эксперимент кезінде жаңа дамытылған әдістің дәстүрлі жылуды потенциалдар әдісінен оңай және тиімді екенін көрсетілген.

**ВЛИЯНИЕ МЕЖДИСЦИПЛИНАРНЫХ СВЯЗЕЙ
НА МАТЕМАТИЧЕСКОЕ ОБРАЗОВАНИЕ СТУДЕНТОВ**

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Ключевые слова: метод МЭФ, междисциплинарная связь, неотъемлемые функции ошибок.

Аннотация. Математически и статистически доказано, что междисциплинарные связи помогают педагогам в разработке новых, эффективных методов, положительно влияющих на академическую успеваемость студентов. Кроме того, в педагогическом эксперименте было показано, что новые разработанные методы являются более простым и понятным по сравнению с традиционным методом тепловых потенциалов для областей с подвижными границами.

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