THE PARTICIPATION OF HIGHER MATHEMATICS IN THE TEACHING OF SPECIALIZED SUBJECTS IN TECHNICAL HIGHER EDUCATIONAL INSTITUTIONS

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Abstract. The main purpose of this article is to present a contemporary overview of this field, which emerged at the intersection between mathematics and energy education.
Key words: integration, mathematics in energy, innovations, mathematical modeling, mathematical competencies.

An area of particular interest for vocational education research is the integration of mathematics as a traditional theoretical subject with specialist subjects in vocational courses. The integration of subjects, if successfully organized, has proven to improve learning outcomes.

Previous research on integration projects has emphasized the importance of organizational structure, such as planning, infrastructure, and time allocated for management support. But soft values such as relationships, collaboration, pedagogical values, and perspectives have received little attention in research.

Pepin and Coke analyzed challenge-based learning contexts as innovative contexts to encourage new types and new qualities of student learning. An important question was what resources were and should be provided to support students' ways of learning and studying in such an innovative learning environment. They noted the impact on the professionalization of university teachers and the learning of students who choose such courses/projects: supporting teachers in developing as appropriate trainers in such complex settings.
charging is required. Students to be self-directed learners and
In addition to appropriate curricula, technological and social resources, teachers using problem-based learning should be supported.

We are in the tradition of viewing mathematical modeling as a central topic that can contribute to energy education by integrating elements of mathematics and energy research into self-regulated modeling activities. Modeling activities can be related to workplace or energy practices. Offering courses in mathematical modeling can be considered innovative at many institutions, some of which have been around for a long time. Assessment of modeling skills and competencies is a major issue in general research on mathematical modeling in secondary and higher educational institutions.

Kortemeyer (2019) and Biehler (2017) studied mathematical practice in electrical engineering courses in a normative sense and in student solution processes and written exams. They learned the math skills required in first-year electrical engineering courses. After analyzing the exercises (from the electrical engineering exam), they introduced a theoretical approach consisting of three elements/concepts: "student-expert-solution", a normative solution called "low-inferential analysis" (for qualitative research with students), and written student solutions division into categories. The authors recreate a method for using

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mathematics integrally in electrical engineering courses, which cannot be adequately described as mathematical modeling, as it is usually conceptualized in mathematics education. The authors proposed a different conceptualization of mathematical praxeology in the field of electrical engineering. Theoretical considerations can also guide the design of innovations. For example, DAN offers perspectives on the design of innovative practices called Learning and Research Pathways.

In order to clearly show the integration of the field of electric power and the science of higher mathematics, we will dwell on the application of the derivative concept to the problems of electric power.

Let's say $q = (t)$ is the amount of electricity that passed through the cross section of the conductor in the time interval t. We denote by Δq the positive charge passing through the conductor in the time interval Δt. Then the current I is equal to the following:

$I = \lim_{\Delta t \to 0} \frac{\Delta q}{\Delta t} = \lim_{\Delta t \to 0} \frac{q(t+\Delta t)-q(t)}{\Delta t}$

i.e , $I = \frac{dq}{dt} = q'(t)$.

For example, if the amount of electricity passing through the conductor from the moment of time t=0 is given by the formula $q = 3t^2 - 3t + 4$, then it is required to find the current strength in the 6th second.

Then $I = \frac{dq}{dt} = q'(t) = (3t^2 - 3t + 4)' = 6t - 3$ finding the derivative and taking into account that $I = 6 \cdot 6 - 3 = 33\ (A)$. So the requested current is 33 amperes.

When solving many problems, the desired function is constructed and its extrema are found. We give two examples of this.

Issue 1. Two light sources are located 25 m apart. If the illumination powers of these sources are in the ratio of 27:8, find the least illuminated point on the straight line connecting the illumination points. Solving. Suppose the sources are located at points A and B, and a strong light source is located at point A. Let us denote the point with the least illumination by C, and if we call the distance from A to C x, then

$CB = 25 - x$. If the light power of the strong source is I, then the light power of the second source should be equal to $\frac{8}{27}I$.

Since the illumination is directly proportional to the light power and inversely proportional to the square of the distance to the light source, and considering that the observed point is illuminated by both sources, the illumination function takes the following form: $E = \frac{I}{x^2} + \frac{8}{27} * \frac{I}{(25-x^2)}$.

We find the derivative of this function $E' = -2\frac{I}{x^3} + \frac{16}{27} * \frac{I}{(25-x)^3}$ and set it equal to zero $(25 - x)^3 - \frac{8}{27}x^3 = 0$ We form the equation, and from this $25 - x = \frac{2}{3}x$. From this $x = 15$.

Now we find the second derivative at this point and check its sign. $E'' = 6\frac{I}{x^4} + \frac{48}{27}\frac{I}{(25-x)^4}$.

Clearly $E'' > 0$, so the function reaches a minimum at the point $x = 15$. Thus, the least illuminated point is from A It is a point 15m away and 10m away from B.

Issue 2. An electric lamp is hung above the center of a circular table of radius r. How high should the lamp be placed from the table so that the book placed on the edge of the table is best illuminated.

Solving. We designate the required height with x. Since the illumination is directly proportional to the cosine of the angle of incidence E and inversely proportional to the square of the distance to the source, we construct the function $E = k\frac{cos\alpha}{R^2}$ (where k = $const$).

From triangle SAO : : $R = \sqrt{x^2 + r^2}$,$cos\alpha = \frac{x}{\sqrt{x^2+r^2}}$.. Then $E = k\frac{x}{(x^2+r^2)^{\frac{3}{2}}}$

We find the derivative of this function $E' = k\frac{r^2-2x^2}{(x^2+r^2)^{\frac{5}{2}}}$ and set it equal to zero to get $r^2 - 2x^2 = 0$ we get, from which $x = \frac{r\sqrt{2}}{2}$. Now we check the sign of the second derivative to make sure that the function reaches a maximum at this value.

Since $E" = k\frac{3x(2x^2-3r^2)}{(x^2+r^2)^{\frac{7}{2}}}$ $E"(\frac{r\sqrt{2}}{2})< 0$ it follows that the function reaches a maximum at this point. So, the book is best illuminated when the lamp is placed at a height of $x = \frac{r\sqrt{2}}{2}$.

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