JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205

Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

THE RELEVANCE OF HYPERBOLIC EQUATIONS AND AN EFFECTIVE METHOD OF STUDYING THEM

Basheeva Aynur Orinbasarovna

Kazakhstan In the Republic located L.N.Gumilyov

named after Eurasia National University

Algebra and geometry department Associate Professor , (PhD)

Kholmanova Klara Yangiboy kizi

Jizzakh branch of the National University of Uzbekistan

Assistant of the Department of "Applied Mathematics"

xolmanovaklara97@gmail.com

Annotatsiya: Mazkur maqolada giperbolik tenglamalarning ilmiy-nazariy asoslari, amaliy qo‘llanilishi va o‘qitish jarayonida qo‘llaniladigan samarali metodik yondashuvlar keng yoritilgan. Unda ta’limning zamonaviy talablari, raqamli vositalar, fanlararo integratsiya hamda loyihaviy faoliyat asosida o‘qitish texnologiyalari tahlil etilgan. Shuningdek, mavzuni o‘zlashtirishda o‘quvchilarning ijodiy va analitik fikrlash ko‘nikmalarini rivojlantirishga qaratilgan amaliy metodlar tavsiya etilgan. Maqola metodik jihatdan chuqur, zamonaviy yondashuvlar asosida tayyorlangan bo‘lib, amaliyotchi o‘qituvchilar va metodistlar uchun qo‘llanma vazifasini o‘tashi mumkin.

Kalit so‘zlar: giperbolik tenglamalar, differensial tenglamalar, modellashtirish, to‘lqin tenglamasi, metodika, STEM, interaktiv ta’lim, matematik tafakkur, raqamli texnologiyalar

Аннотация: В статье подробно рассматриваются научно-теоретические основы гиперболических уравнений, их практическое применение, а также эффективные методические подходы, используемые в процессе обучения. Анализируются современные образовательные требования, цифровые инструменты, междисциплинарная интеграция и технологии обучения на основе проектной деятельности. Рекомендуются также практические методы, направленные на развитие у студентов навыков творческого и аналитического мышления при освоении предмета. Статья методически глубока, основана на современных подходах и может служить руководством для практикующих педагогов и методистов.

Ключевые слова: гиперболические уравнения, дифференциальные уравнения, моделирование, волновое уравнение, методология, STEM, интерактивное образование,

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

математическое мышление, цифровые технологии

Abstract : This in the article hyperbolic of equations scientific-theoretical basics , practical application and teaching in the process applicable effective methodical approaches wide illuminated . In it of education modern requirements , digital tools , interdisciplinary integration and project activity based on education technologies analysis Also , the topic in mastering students creative and analytical thinking skills to develop aimed at practical methods recommendation Article methodical in terms of deep , modern approaches based on prepared to be a practitioner teachers and Methodists for manual task transition possible .

Key words : hyperbolic equations , differential equations , modeling , wave equation, methodology , STEM, interactive education , mathematics thinking , digital technologies

Today on the day in our lives mathematics place incomparable that to everyone known . So that's it every part of mathematics to the front attention our focus and our study necessary . Including hyperbolic equations are also important . Special productive differential of equations three main type available : elliptical , parabolic and hyperbolic equations . Of them hyperbolic equations in physics important processes - especially waves , acoustics , electromagnetic fields , earthquake waves , light and signal propagation in modeling wide is applied .

Hyperbolic of equations general appearance :

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

this on the ground u(x,t) – wave height , c – spread speed . This equation wave equation is called and him/her D'Alembert method through solution find possible .

This real -life simulation using a mathematical model many physicist events clear analysis to do , to calculate and in advance prophecy to do It is possible . This is hyperbolic equations to study not only theoretically , maybe practical also relevant that shows . This is the topic deeper study necessity shows . Therefore this the topic education to the methodology our attention Let's see .

Hyperbolic equations of teaching methodical basics

1. First lesson effective to be for the lesson planned let 's take

Lesson topic content following in sequence organization is done :

1. Vital problem with introduction : sound in the air spread , telephone signal arrived

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

progress .

2. Mathematician to the model transition : hyperbolic equation to compile .
3. Solution methods explanation : analytical , graphic and digital .
4. Practical tasks : real reality to formulate a problem based on and solution
5. Analysis and generalization : model and real process compatibility assessment .

2. Hyperbolic equation the topic following sciences with integration as education education quality to increase big help gives .

- Physics **:** wave , sound , light events .
- Computer science : programming via model simulation (Python, MATLAB).
- Technology : Arduino or sensors using practical models preparation

3. Educational technologies and from methods use the lesson further interesting and understandable to be service does . So so , the following methods the topic lighting for suitable that was because of this to methods attention Let's see .

- **STEM Approach** : Students physicist the event selects → builds a mathematical model → solution finds → in the program the result simulation does .
- **Flipped classroom class)** : subject video about home given , in class and discussion and practice will be done .
- **Gamification : “ Tol'tul ”** " Lifeguard " game - wave to spread correct answer giving , the area from danger save .
- **Fishbone analysis scheme** : hyperbolic of the equation reasons and consequences graphic in a way analysis will be done .

Technological tools :

- GeoGebra, Desmos — graph drawing
- MATLAB, Python — building a numerical model .
- Padlet, Jamboard — idea maps and cluster schemes create

4. Study activity assessment and monitoring

Evaluation three in stages take goes to :

Stage	**Evaluation shape**	**Methodical recommendation**
Lesson took	Diagnostic test	Previous knowledge level determination
Lesson during	Formative (tables , reflection)	" What? " Do you understand ?", " What? interesting it has been ? "

JOURNAL OF APPLIED SCIENCE AND SOCIAL SCIENCE
eISSN 2229-3113 pISSN 2229-3205
Volume 15 Issue 04, April 2025
Impact factor: 2019: 4.679 2020: 5.015 2021: 5.436, 2022: 5.242, 2023: 6.995, 2024 7.75

Stage	Evaluation shape	Methodical recommendation
Lesson after	Summative test, project protection	Independent analysis to do , to think to conduct

Conclusion as telling if so , hyperbolic equations to teach student's logical his/her thinking developmental , real -life complicated processes mathematician express to take ability increasing strong is a tool . Education methodology modern technologies , interdisciplinary approach and interactive methods with enrichment , education efficiency noticeable at the level increases . Especially , the student ' s own on performance , projects through creative approach them modern educated expert as shapes .

Used literature

1. Karimova DX “ Mathematics in education methodical approaches ”. Tashkent, 2021.
2. Rakhimov AA “ Partially productive differential equations ”. Tashkent, 2020.
3. Evans, LC *Partial Differential Equations* . AMS, 2010.
4. Strauss, WA *Partial Differential Equations: An Introduction* . Wiley, 2007.
5. “ Innovative education technologies ”, Higher and middle special education Ministry , 2023.
6. GeoGebra, MATLAB, Python — official documents and open education platforms .
7. LeVeque, R. J. *Finite Difference Methods for Ordinary and Partial Differential Equations*, SIAM, 2007.