

# Toward the renewal of the “teacher-scientist” concept of Roland Eötvös

On the Content Pedagogy Research Program of the  
Hungarian Academy of Sciences (2016-2020)

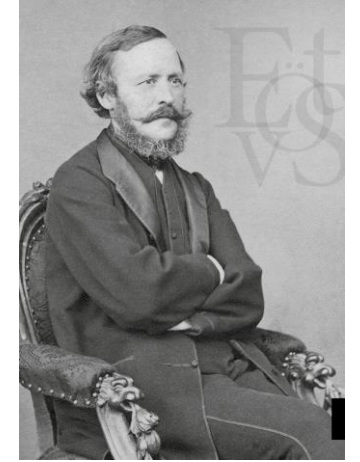


András Patkós, prof. em., member of HAS  
Institute of Physics, Eötvös Loránd University



# Pedagogical legacy of Roland Eötvös (1848-1919)

Faithful follower of his father, minister of Cults and Education (1868-71)



Joseph Eötvös

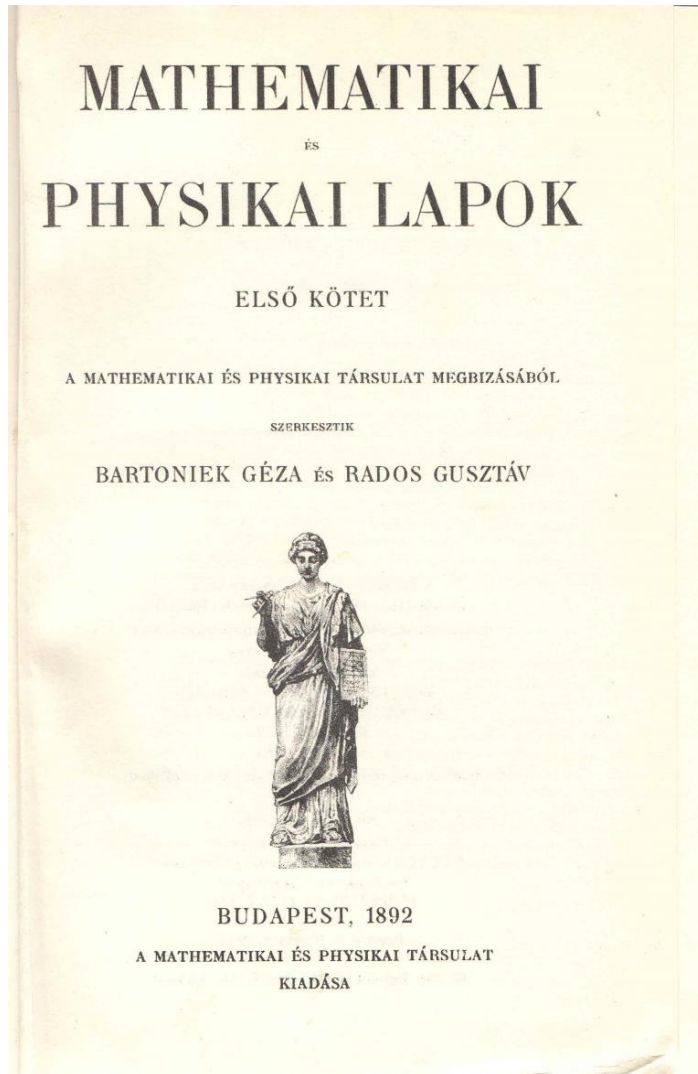
- Proposition (1874) and realisation (1895) of **Joseph Eötvös College, teacher training college à la École Normale Supérieure**
- Foundation of the **Mathematical and Physical Society** (MPS, 1891) and its monthly Journal,
- Encourages foundation of a **separate journal** (Dániel Arany, 1894) **and a problem solving competition** (MPS, 1895) **for high-school students**
- **Chair of the Teacher Examination Board** of Budapest University (1896-1919)



# Eötvös' views on teachers

“The quality of teaching depends in first place on the  
**scientific preparedness of the teachers.**”

# The “teacher-scientist” concept



“We shall write this journal for ourselves, **not to publish original new results**, but for **presenting the latest results of the world science pedagogically, that every teacher could follow and make use of it in the teaching procedure.**”

“Let us **train teachers to scientists**, not just for the sake of better teaching, but also **to keep alive their creativity with the magic of science against the indifference caused by the repetitive daily teaching obligations.**”

An outstanding teacher-scientist:

László Rátz (1863-1930)

High-school director, mathematics teacher,  
Editor of High-school Math. and Phys. Journal



Famous pupils (discovered and mentored by L.R.):

Eugene Wigner (“first nuclear engineer”)

John v. Neumann (“proposer of Von Neumann architecture”)

The **László Rátz prize for pedagogical oeuvre** in  
Biology/Chemistry/Physics/Mathematics teaching  
the highest appreciated teacher’s recognition

Attractiveness of science careers I.

**Chance for scientists:  
become founder of  
yet non-existing industries!**

You might ask me the Morgan-Stanley Hungary story

# The original concept of Eötvös is not sustainable

- Starting the second half of XXth century it became increasingly difficult to “present the latest results of the world science pedagogically that every teacher could follow”.
- Hierarchically complex organisation of scientific knowledge (genes, quarks, black holes and other “hypothetical” objects)
- Voluntarist teaching “modernisation” attempts resulted in indigestible curricula
- Frustrated teachers resisted to curricular reforms
- Frustrated students turned away from science (to **pseudoscience**)



“Science ends where marvel starts.” (R. Eötvös)

“Dancing galaxies”



“Cosmic whirling”



These pictures were NOT made by the James Webb Telescope



# Content Pedagogy Research

“The clever physics community has already found an approach for **how make progress in areas where one’s initial intuition is obviously flawed**, e.g. figuring out the structure of atoms.

That approach is to **rely on careful objective experimental measurements and to use that data to develop new improved understanding and intuition.**

For teaching physics, this means **looking at data on how people learn and how students do and don’t learn the various topics in physics.”**



Carl Wieman

Nobel Prize in Physics,  
2001

# Research methodology (DBR, PER and others)

“How to get pedagogically relevant knowledge?  
From **pedagogical experiments conducted in strict scientific framework** conform with general norms of scientific research.  
In addition, the methods and conclusions should be submitted to the **control of the teacher's community**.  
One has to arrive to a common understanding with 200,000 Hungarian teachers about the really existing problems in the schools and their suggested resolutions.”



József Zsolnay, 1994

# Content Pedagogy Research Program of HAS, 2016

## Key research directions

- scientific foundation for new complex teaching methods
- renewal of Hungarian teaching traditions and study aids
- praxis oriented renewal of the pedagogical aspects of knowledge transfer

**In the research staff Inclusion of practicing teachers was required**

## Required workplan items

- A hot problem of Hungarian public education (with international context)
- Proposed resolution, outline of the promised teaching products
- **Expression of interest from testing educational institutions**
- Evaluation of the efficiency of the interventions, dissemination of the results

# Content Pedagogy Research Program of HAS, Facts

- 71 applications --> expert assessment --> **19 supported groups**
- Budget: cca. EUR 65,000/yr + EUR 30,000 for the extension year
- **Science: 6, Technology+Engineering: 2, Mathematics: 2 groups**
- Further subjects:  
English teaching, Bilingual sign language teaching, Digital literacy, Autism, Music pedagogy(2), Visual culture, Oral history, Cathecism
- Full staff: 740, **active teachers: 334, PhD-students: 70**
- Program supervision: Program Council (19 group leaders + 11 experts)  
Program Council discussed yearly reports to the General Assembly of HAS  
4 public conferences/year, where groups reported on their activities

# Content Pedagogy Research Program of HAS, Facts

- Each yearly report evaluated by **2 Hungarian experts** [among them **some active teachers**]
- 14 group reports were additionally evaluated by one or two of 10 foreign “friendly critics”, [among them: Jari Lavonen (U. Helsinki), Mira Kallio-Tavin (U. Aalto), Ritva Takkinen (U. Jyväskylä)]
- At the closing meeting of the Program **56 teacher participants received a**

**Honoring Diplom of the President of the Academy of Sciences**







# Content Pedagogy Research Program of HAS

## Qualitative Progress

- from valuable pedagogical actions to educational research projects
- from isolated researchers/groups to wider community with many horizontal interconnections
- in gaining professional authority within academic establishment
- in providing **new perspectives to active teachers for scientific collaboration with academia (cooperation in testing and implementing innovative pedagogies)**

# Attractiveness of science careers II.

## Authenticity of science teaching:

teacher's personal experience in scientific activity

Other new channels strengthening school-research ties:

- 1500 researchers offered motivating events in their former schools by the initiative of the President of HAS
- Outreach officers employed in research institutes:

Visit to and offer for further education courses at large research facilities (example: European Light Infrastructure, Szeged, HU)

# Sample results: science education

- MTA-SZTE **Science Education Research Group**

Developing **scientific reasoning of students** via content development

5-volume teacher's handbook; **46 active teacher** participants

- MTA-ELTE **Physics Education Research Group**

Teacher Program of the Graduate School of Physics

**17 teachers obtained PhD-degree** between 2016-2020

**27 active teacher** participants (papers to GIREP meeting, 2019)

- MTA-ELTE **Research Group on Inquiry-Based Chemistry Education**

24 experiments newly designed and adapted to student's level

longitudinal monitoring of advances and attitudes

**32 active teacher** participants (worksheet design)

2 papers in world-leading journal of chemistry education



## Chemistry Education Research and Practice

The journal for teachers, researchers and other practitioners in chemistry education. CERP is free to access thanks to sponsorship by the Royal Society of Chemistry's Education Division

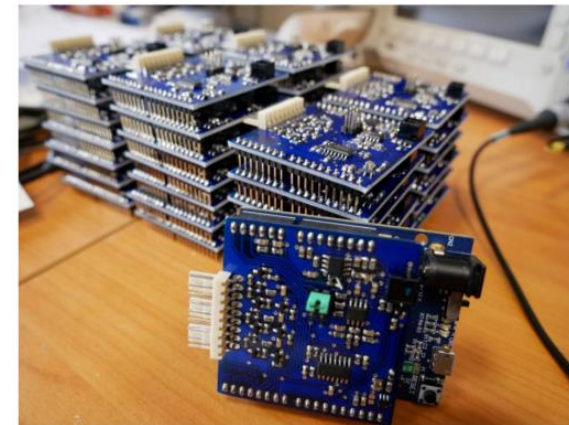
# Sample results:

## Innovative universal instrument for school science

- MTA-SZTE Research Group on **Technical Informatics Methodology**
- **sensor-computer interface built** on inexpensive Arduino board enables quantitative studies of wide range of phenomena
- **5 teacher participants** developed a complete set of introductory high-school physics measurements (2146 **downloads of the in-service course documentation till end of August 2021**)
- 32 boards distributed among collaborating schools, interested foreign physics teachers
- 7 international publications, mainly in journals of physics education (**1119 downloads**)
- Subproject of MTA-ELTE Physics Education Group: Use of **Arduino-controlled sensors in physics classes and physics clubs**



Z Gingl , project leader



Arduino boards donated to schools





The Arduino-based  
**robot-builder**  
**club** of Sopron

Some successfully realized projects: [Automated flower watering](#) (sensing water level, temperature etc.)  
[Door opening and closing with RF identification](#)

# Sample results: activity based geography teaching

- MTA-SZTE Research Group on **Geography Teaching and Learning**
- Worksheets for 20 regions of Hungary (accessible also via internet, smart phones)
- **Problem based complex presentation** of physical geography, **climatic&environmental situation**, economics, industries and agriculture, cultural and touristic institutions of each region
- **QR-codes** lead further to specific aspects, **inquiry based mini-projects for students** to explore their own region
- **Dissemination among teachers** via newly founded electronic journal *“Geometodika”*; since 2019 nearly 60.000 visitors



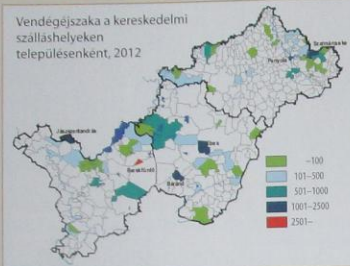
Andrea Farsang  
project leader  
(member of HAS,  
**didactics of geography**  
appears as first item  
on the list  
of her research interests)





A Tisza-tó tájegységei és a part menti települések

Fordít: www.tiszafured.hu



4

Ti vagytok Tiszafüred és a környékbeli települések polgármesterei, képviselői. Tervetek az, hogy a Tisza-tó turizmusát szeretnétek fellendíteni. Alakítsatok munkacsoportokat, és dolgozzatok ki egy turisztikai stratégiát általános vagy középiskolás gyerekek és családjaik vagy osztályaik számára!

#### 1. munkacsoport: Utazásszervezés

- Értékeljétek a Tisza-tó régió közlekedésföldrajzi helyzetét!
- Ajánljatok utazásszervező honlapokat, módokat! Illusztráljátok példával!
- Hogyan juttok el lakóhelyetekről Tiszafüredre? Állapítsátok meg a [menetrendek.hu](http://menetrendek.hu) oldal segítségével!

#### 2. munkacsoport: Turisztikai alapismeretek

- Nevezzétek meg a Közép-Tiszavidék legfontosabb turisztikai vonzerőit!
- Járjatok utána, hogy mit jelentenek ezek a kifejezések: kereskedelmi szálláshely, vendégéjszaka!
- Hogyan lehet növelni a vendégéjszakák számát a térségben?

#### 3. munkacsoport: A Balaton rivalisa?

- A Tisza-tó kialakításakor voltak, akik azt gondolták, hogy a Balaton rivalisa lehet. Erveljétek ellene és mellette!
- Milyen kapcsolat van a régió földtani szerkezete és a termálvíz-előfordulások között?

#### 4. munkacsoport: Turisztikai fejlesztési lehetőségek

- A megadott honlapok segítségével gyűjtsétek össze, milyen idegenforgalmi lehetőségek érdekelnek az általános iskolás és középiskolás korosztályokat! **QR 12-18**

A munkacsoportok megbeszélésének eredményeként készítsétek térképpel, képekkel illusztrált poszttert a Tisza-tó turisztikai jelentőségéről! Találjátok ki hozzá saját jelrendszert! A legjobbban sikerült munkából szervezzétek hagyományos vagy virtuális kiállítást!

QR 12



QR 13



QR 14



QR 15



QR 16



QR 17



QR 18



#### Meglepetésekkel teli táj

Magyar Atlantisz, PET Kupa, ököcentrum, téli üzemmód.

Négy kifejezés, amelyek mind a Tisza-tóhoz és környékéhez kapcsolódnak. **QR 19-22** Fedezték fel őket!

MF

QR 19



QR 20



QR 21



QR 22



## Vadregényes vízi világ – A Tisza-tó és a Közép-Tiszavidék múltja és jelene



### A folyószabályozás következményei

- 1.1. Helyezd el a megadott településeket a Tisza mentén: Vásárosnamény, Tokaj, Szolnok, Szeged! Jelöld kék szinnel a Tisza-tavat!



- 1.2. Készíts grafikont a következő adatokból a Tisza szabályozás előtti és szabályozás utáni árvízszintjének magasságaiból!

Észlelőhely	Szabályozás előtt
Vásárosnamény	900 cm
Tokaj	870 cm
Szolnok	830 cm
Szeged	890 cm

Észlelőhely	Szabályozás után
Vásárosnamény	840 cm
Tokaj	720 cm
Szolnok	680 cm
Szeged	610 cm

- 1.3. Válaszolj a kérdésekre a grafikon segítségével!

Hogyan változott az árvíz legnagyobb magassága a folyószabályozás után?

A folyószabályozás mely tevékenysége okozta ezt a változást?



Attractiveness of science careers III.

Exploration web-based information resources  
following student's initiatives

# Sample results: Renewing Rátz's legacy

- MTA-Rényi Research Group on **Discovery Learning in Mathematics**

- Start: **Pósa-camps** for highly gifted students

in 25 years 1500 students attended weekend math camps

last 10 years 57 (out of 60) members of Hungarian IMO team

- Goal: **application of Pósa-method beyond highly gifted students**

4-year long experimental math teaching in 3 parallel classes

**Flying School:** visiting mainly **underprivileged schools** (113 schools, 2730 students) offering 3-4 hours inspiring math activity for grade 9 students;

regional talent nurturing program: monthly math-day

2021: **Alfréd Rényi Mathematical Institute opens Dept. of Mathematics Education;**

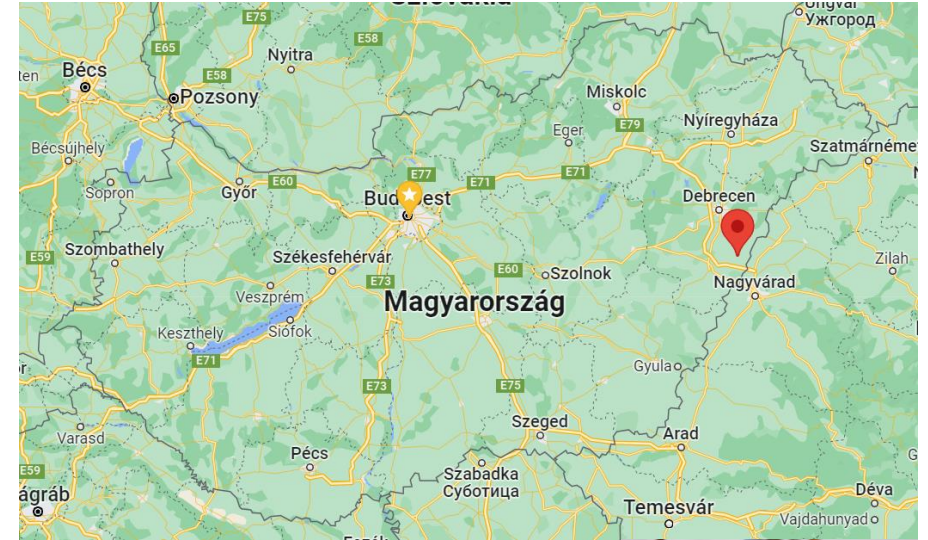
**Head: Péter Juhász, teacher of math at Szt. István High School**





# Sample results: promoting students of low social status

- MTA-DE Research Group on **Foreign Language Teaching**
- **Where?** Hosszúpályi, Hajdubagos, Esztár (small villages in Eastern-Hungary)
- **For whom?** 71 grade 5&6 students, 43 from (mainly roma) families living on social periphery
- Preparation: sociological survey of student's motivations (1 international publication)
- **What?** HANNA for learning English with tablets (1 international publications)
- **Conference talks and co-authoring teacher's handbook by involved English teachers**

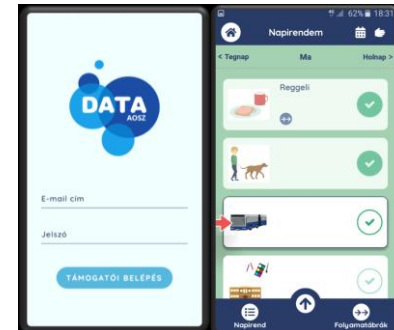
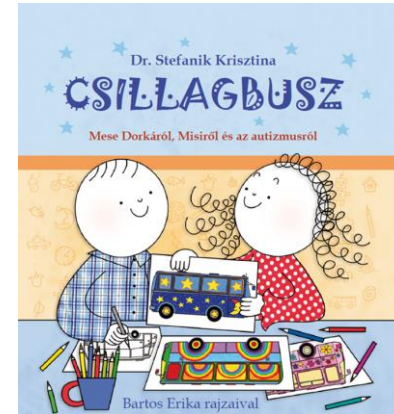


Tünde Polonyi  
project leader



# Sample results: educational inclusion of children with autism

- MTA-ELTE **Autism in Education Research Group**
- Survey on the quality of life of families (N=519) with children with autism
- Developing a **novel method for advancing inclusion** of children with autism in mainstream classes: **'Star-bus' Inclusion Intervention Programme** (SIIP)
  - Evaluating the method in a **field study with volunteering teachers** & classes (14 classes, 281 students)
  - **Accredited teacher further education programme**, first course starting soon
  - Cooperation with the AutiSpektrum Association (NGO)
- **Consortium with the Hungarian National Autism Society (NGO)** in a project for developing app-based services for people with autism (DATA Project & System)
- Several talks at international & domestic conferences



Miklós Győri project leader



Attractiveness of science careers IV.

Mathematically solidly educated informaticians  
massively and urgently needed

Science related professions promise more  
direct way for elevation of social status

# Sample results: Renewing traditions

- MTA-SZTE **Music Education Research Group**
  - Problem: *solmisation* core of the world-famous **Kodály-method** of music education students find annoying, singing classes at the bottom of the popularity rankings
  - Project: **Adventures on Music Island** (Kalandok a Zeneszigeten) digital application close in style to video games aiming at 1st-to-3rd grade students.
  - Distance-education forced by pandemic aroused huge interest:
    - > 200 succesfull completion of a web-based in-service course
    - 5.866 visitors of the web-site from 23 countries
    - Google Play web-shop: dowloaded on 347 Android based tools
    - From the web server of the group 852 downloads (Windows)
  - English version in advanced stage, Chinese version (PhD-work)
  - 1 PhD-degree, 2 related international publications
- Knowledgeable music teachers using advanced digital technology**



Márta Janurik  
project leader

# New phase: Public Education Research Program (2021-2024, 2022-2025)

- Two subsequent calls (2021,2022)
- Thematic extension beyond content pedagogy
- 2021-2024: 20 research groups
- 2022-2025: 7 further groups
- Budget: EUR 75.000/yr
- Chairman of Programme Council: Prof. Benő Csapó

**Many thanks for your attention!**