

The Evolution of Mathematics Teaching Practices, c. 1770-1970

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Encyclopedias as Signs of Disciplinary Maturity

- Critical mass of professional scholars with varied research
- Presentation of research to popular audience
- Alexander Karp and Gert Schubring, eds., *Handbook on the History of Mathematics Education* (Springer, c. 2013)
 - Methodology
 - Nations
 - Subjects
 - Comparative Education

Historiographical Challenges for a Brief Chapter on Teaching Practices

- Scope vs. Length
- Decentralized Evidence
 - Textbooks
 - Institutional Histories
 - Administrative Records
 - Examinations
 - Class Notes
 - Memoirs
 - Obituaries
- Identification of Turning Points

Types of Teaching Practices

Lecture

John Playfair

- University of Edinburgh Professor of Mathematics (1785-1805)
 - Algebra
 - Geometry
 - Fluxions
- University of Edinburgh Professor of Natural Philosophy (1805-1819)
- Student Notes
 - James Borthwick, 3 vol., 1806-1807, Edinburgh University Library
 - Anonymous Student, 3 vol., 1808-1809, Edinburgh University Library

John Farrar (Hollis Professor of Mathematics, Harvard, 1805-1836)

His were the only exercises at which there was no need for a roll-call. No student was willingly absent. The professor had no notes, and commenced his lecture in a conversational tone and manner, very much as if he were explaining his subject to a single learner. But whatever the subject, he very soon rose from prosaic details to general laws and principles, which he seemed ever to approach with blended enthusiasm and reverence, as if he were investigating and expounding divine mysteries. His face glowed with inspiration of his theme. His voice, which was

unmanageable as he grew warm, broke into a shrill falsetto; and with the first high treble notes the class began to listen with breathless stillness, so that a pin-fall could, I doubt not, have been heard through the room. This high key once reached there was no return to the lower notes nor any intermission in the outflow and quickening rush of lofty thought and profound feeling, till the bell announced the close of the hour, and he piled up all the meaning that he could stow into a parting sentence, which was at once the climax of the lecture, and the climax of an ascending scale of vocal utterance higher, I think, than is within the range of an ordinary soprano singer.

—Andrew Peabody (A.B. 1826), Quoted in Cajori, *Teaching and History* (1890)

Public Defense of Theses/Oral Examinations

Account by de Brosses of Maria Agnesi's Disputation, 16 July 1739

I was brought into a large fine room, where I found about thirty people from all countries of Europe, arranged in a circle and Mlle Agnesi, all alone with her little sister, seated on a sofa. She is a girl of about twenty years of age, neither ugly nor pretty, with a very simple and very sweet manner. ... Count Belloni, who took me, wanted to make a public show. He began with a fine discourse in Latin to this young girl, that it might be understood by all. She answered him well, after which they entered into a dispute, in the same language, on the origin of fountains and on the causes of the ebb and flow which is seen in some of them, similar to tides at sea. She spoke like an angel on this topic, I have never heard anything so pleasurable. ...

She is much attached to the philosophy of Newton, and it is marvellous to see a person of her age so conversant with such abstract subjects. Yet however much I was amazed at her learning, I was perhaps more amazed to hear her speak Latin with such purity, ease and accuracy. . . .

Junior & Senior Mathematical Theses, Harvard, 1782-1839

- 406 Total
 - 62 on Projection of Solar Eclipse
 - 44 on Projection of Lunar Eclipse
 - 33 on Algebraic Problems
- 1803: John Farrar, Calculation and Projection of a Solar Eclipse for Lat. 39° , $54'$ S.; 116° , $30'$ E. (20 $\frac{3}{4}$ x 29 $\frac{1}{4}$ in.)
- 1817: George Bancroft, *Invenire Motum Verum Nodorum Lunae* (in Latin) (21 $\frac{1}{4}$ x 26 $\frac{3}{4}$ in.)
- 1829: Benjamin Peirce, Solutions of Questions . . . From the *Mathematical Diary*, &c. (8 x 10 in. booklet, 24 pages.)

List of Theses and some samples are posted at:
<http://oasis.lib.harvard.edu/oasis/deliver/~hua17>

Recitation

- Students Prepared at Home and Presented Theorems at Blackboard
- Effective Management of Increasing Class Sizes
- Yale Students Were Notorious for Their Tradition of Burying Euclid (Playfair's *Elements of Geometry*) at the End of the Geometry Course; They Even Sang Songs About It (Edward C. Porter, *Songs of Yale* (1858))

No more we gaze upon that board
Where oft our knowledge failed,
As we its mystic lines ignored,
On cruel points impaled.

We 're free ! Hurrah ! from Euclid free !
Farewell, misnamed Playfair,
Farewell, thou worthy Tutor B.,
Shake hands, and call it square.

Swell, swell the chorus, Each jolly Sophomore !
For Euclid's shade no more shall haunt
The class of Fifty-four.

Written Examinations

- On Exit: The Cambridge Tripos
- On Entrance: Harvard
 - 1803: Arithmetic up to the Rule of Three
 - 1820: Algebra
 - 1844: Geometry
- Never: The Scottish Universities
- MIT Entrance Exam, 1869-70
(<http://libraries.mit.edu/archives/exhibits/exam/>)

Teaching By Experiment

Models and Manipulatives

Josiah Holbrook, 1833

Friedrich Froebel (1782-1852)

See also: <http://americanhistory.si.edu/teachingmath/>

Evolution of Textbooks

- For instance, compare the format, detail of proofs, exercises, illustrations, and typography from:
 - John Playfair, *Elements of Geometry* (Edinburgh, 1795)
 - To:
 - Webster Wells and Walter W. Hart, *Plane and Solid Geometry* (Boston: D. C. Heath, 1915)

Summing Up

- Unwieldy Evidence
- Essential Tension Between Memorization and Experience
- Trickle-Down Effect from Colleges