

- *История и философия на химията* •
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EDUCATION AND CURRICULA IN EARLY UNIVERSITIES: SOME DOCUMENTARY EVIDENCE

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Abstract. Several European documents dating from as early as 13th Century (including laws, papal Bulls, and University records) are cited demonstrating that the importance of the syllabus or organized and planned education was recognized in the earliest Universities. The quoted texts are related to science, mostly medical, education. A collection of laws originating from 8th Century Japan is also cited that sheds light on the methods of education in the Far East. An evidence of planning in medical education and of an early form of “curriculum” in that region is presented.

Numerous discussions have been dedicated to the role of curricula and of a defined system in education. Since curricula are crucial to the formation of well-educated students and due to their fundamental importance in modern education, it is interesting to trace their origins. Curiously, the very first universities, being much less “primitive” than is often thought, had their own curricula, which were constantly being modified in order to meet the requirements of students, teachers, or certain authorities. Subjects and books were added or removed (or even banned!) from syllabi as evidenced from documents dating from the time when the early universities were established. Translations of such texts are not readily available but are rather scattered in various monographs and articles on the subject. Several examples are presented in order to demonstrate that the importance of the curriculum, i.e. detailed list of subjects and

texts to study within an appropriate timeframe, in science education was indeed realized in the very early stages of university education. Hopefully, the efforts made by early scholars and educators to introduce an order in science education aimed at improving the quality of teaching and learning, will be an eye-opener for many contemporary specialists in the field of education.

Early European Universities and Their Curricula

Education in medieval Europe, although adapted to agree with the Christian religion, was largely based upon ideas derived from the Ancient Greek and Roman civilizations. However, the aims of the Greco-Roman and early medieval education were different: while the former gave young people general and not quite systematic knowledge in various fields considered important for a well-rounded person, the latter trained professionals skilled in particular art or science. In other words, training even in the very first European universities (those of Bologna and Paris) was more career-oriented. How early universities evolved from small church or cloister schools can fill volumes. The curious reader is referred to some excellent monographs [1,2]. Herein, we will present some documentary examples demonstrating that early scholars were quite aware of the significance of focus, system, and planning in teaching. At a time when there was no such concept as “natural sciences”, medicine was perhaps the closest to what a contemporary person would define as a combination of anatomy, botany, toxicology, biology, chemistry, and physics. Thus, most of the documents we cite as examples are related to the study of medicine.

Compulsory texts in science curricula in Europe

Perhaps the earliest law for the regulation of the practice of medicine was issued by the German emperor (from 1220 to 1250) Frederick II Hohenstaufen in 1240 or 1241. The law, quoted in the Journal of the American Medical Association, is remarkable, for it illustrates the attention paid by some authorities, even at this early time, to the quality of education. It implies that there were several books that had to be read and understood by everyone who wanted to practice medicine after attending the University of Salerno: *“In consideration of the serious damage and irreparable suffering which may occur as a consequence of the inexperience of physicians, we decree that in future no one who claims the title of physician shall exercise the art of healing or dare to treat the ailing, except such as have beforehand in our University of Salerno passed a public examination... Since the students cannot be expected to learn medical science unless they have previously been grounded in logic, we further decree that no one be permitted to take up the study of medical science without beforehand having devoted at least three full years to the study of logic... After*

having spent five years in study [of medicine] he shall not practice medicine unless he has during a full year devoted himself to medical practice with advice and under the direction of an experienced physician. In the medical schools the professors shall during these five years devote themselves to the recognized books, both those of Hippocrates as well as those of Galen, and shall teach not only theoretic but also practical medicine.” [3]

A very early text, originating from the University of Paris (1270-4) already demonstrates quite clearly that there were several obligatory texts for a scholar to read and be examined on before he could be allowed to teach (or perhaps, to practice) his art. The document reads: *“Let it be known that bachelors in the faculty of medicine wishing to open a course for the first time are held on oath to all the following requirements... They shall assure the dean or his locum tenens or before the whole faculty that they have attended lectures in medicine for three years and are in their fourth year of which they have attended for five months. And if for each of the said years the bachelor has not spent nine months in the study of medicine, nevertheless the license for giving a lecture course shall be granted him provided he has diligently studied in the said science at Paris for thirty-two months, that is, hearing ordinary lectures and not counting in time of vacations... Also, they shall swear that the text on which they are to lecture cursorily they have heard ordinarily... The form as to texts heard is that he should have heard twice in ordinary lectures the art of medicine and once cursorily except the “Urines” of Theophilus, which it is enough to have heard once ordinarily or cursorily; the “Viaticum” twice in ordinary lectures, the other books of Isaac once in ordinary, twice cursorily, except the “Particular Diets” which it is sufficient to have heard cursorily or ordinarily; the “Antidotarium Nicholai” once. The “Verses” of Egidius are not on the form. Also he should have read one book of theory and another of practice.” [4]*

On September 8, 1309, Pope Clement V (1305-14), advised by the influential Arnaldo da Villanova, legalized in a Bull a syllabus and requirements for degrees at Montpellier. Every candidate for the degree of master of medicine had to own books by Galen (*“De complexionibus”, “De malicia complexionibus diverse”, “De simplicibus medicina”, “De crisi et criticis diebus”, “De morbo et accidente”, and “De ingenio sanitatis”*) and Avicenna or Rhazes, Constantine the African or Issac Judaeus. He also must read three books out of a list of nine: *“Antidotarium nicolai”, Hippocrates’s “Aphorismi”, “Prognostici”, and “De regimine acutorum”, Johannitius’s “Isagoge”, Isaac Judaeus’s “Liber februm”, and some of Claudius Gelen’s works listed above. In 1340, the list of books did not change but according to the new statutes, the books had to be taught in an orderly way. [5]*

Pope John XXII (1316-34) authorized the institution of chairs of medicine in the University of Perugia by issuing a Bull in February 1321. The entire text of the document (both in the original Latin and in English translation, which

has been used here) is given in the book of Walsh.[6] This decree illustrates the care that the Church authorities took to ensure a high quality of education (much as a surprise to those eager to attach the epithet “dark” to the Middle ages). This was to be achieved by a careful selection of experienced Professors, by requiring that certain disciplines were taught for a sufficiently long period at the University and by a thorough final examination before granting a degree to the students. The “curriculum” was to be based on that of highly respected universities such as Paris (the oldest in Europe) and Bologna. The new alumnus needed not to merely take the exam but also to obtain a good “recommendation” from his teachers in order to secure obtaining his scientific title. Apparently, the recommendation letter is not a new “invention”, but has been used as an important addition to one’s CV for quite some time. The abbreviated papal bull runs: “... *We decree by Apostolic authority that if there are any who in the course of time shall in that same university [of Perugia] attain the goal of knowledge in medical science and the liberal arts and should ask for license to teach..., that they may be examined in that university... and be decorated with the title of Master in these same faculties. We further decree that as often as any are to receive the degree of Doctor..., they must be presented to the Bishop of Perugia..., who having selected teachers of the same faculty in which the examinations are to be made..., to the number of at least four, they shall come together without any charge to the candidate and, every difficulty being removed, should diligently endeavor that the candidate be examined in science, in eloquence, in his mode of lecturing, and anything else which is required for promotion to the degree of doctor or master. With regard to those who are found worthy their teachers should be further consulted privately, and any revelation of information obtained at such consultations as might redound to the disadvantage or injury of the consultors is strictly forbidden. If all is satisfactory the candidate should be approved and admitted and the license to teach granted...In order that the said university may... more fully grow in strength, according as the professors who actually begin the work and teaching there are most skillful, we have decided that until four or five years have passed some professors, two at least, who have secured their degree in the medical sciences at the University of Paris..., and who shall have taught or acted as masters in the before-mentioned University of Paris, shall be selected for the duties of the masterhips and the professional chairs... and they shall continue their work... until noteworthy progress in the formation of good students shall have been made. With regard to those who are to receive the degree of doctor in medical science, it must be especially observed that all those seeking the degree shall have heard lectures in all the books of this same science which are usually required to be heard by similar students at the universities of Bologna or of Paris and that this shall continue for seven years. Those, however, who have elsewhere received sufficient instruction in logic or philosophy having applied*

themselves to these studies for five years in the aforesaid universities, with the provision, however, that at least three years of the aforesaid five- or seven-year term shall have been devoted to hearing lectures in medical science in some university, and according to custom, shall have been examined under duly authorized teachers and shall have, besides, read such books outside the regular course as may be required may... also be allowed to take the examination at Perugia." [6]

The syllabus was not exclusive for the studies of medicine but was apparently widely appreciated by the adepts from other faculties and disciplines. A text dating from about 1366 lists in some detail the books that a scholar from the faculty of arts at the University of Paris should be familiar with: *"We decree... that scholars, before they are admitted to determining in arts, be properly trained in grammar and have heard the "Doctrinale" and "Graecismus", provided the said books are read in the schools or other places where they have learned grammar. Also, that they have heard the entire "Ars vetus", the book of "Topics" or at least four books of it, and the "Elenchi", "Prior" and "Posterior Analytics" completely; also "De anima" in whole or part. Also, that no one be admitted to determining in arts unless he has studied at Paris for two years at least, all dispensation being prohibited. Also, that no one be admitted to the licentiate in the said faculty either in the examination of the Blessed Mary or in that of Saint Genevieve, unless in addition to the aforesaid books he has heard at Paris or in another university the "Physics", "Generation and Corruption", "Celo et mundo", "Parva naturalia", namely the books "De sensu et sensato", "De sompno et vigilia", "De memoria et rimiriscentia", "De longitudine et brevitate vitae", the "Methaphysics" or that he will hear it and that he has heard other mathematical works. Also, that no one henceforth shall be admitted to the degree of master in arts unless he has heard the said books, also the moral works, especially most of the "Ethycs", and the "Meteorology", at least the three first books, all dispensation being prohibited."* [7]

The students of arts and medicine at the University of Bologna had to attend lectures on philosophy (based mostly on Aristotle's works such as the *"Physics"*, *"Physiognomy"*, *"Metaphysics"*, etc.), medicine (including various works by Avicenna, Galen, and Hippocrates), and astrology (which included mathematical works such as Euclid's *"Geometry"*). It is interesting to note that an outline is given in the *"Statuti"* of the University (rubric 68, pp. 274-6) [8] showing which works were read during the first, second, third and fourth years of study. Thus, the syllabus was gradually taking the shape familiar to us today — it should not only list works of study but also prescribe the time dedicated to each one of them. An example dating from 1439 (regulations of the Faculty of Medicine, Caen) illustrates this: *"Within fifteen days after the candidate's admission to the degree of bachelor he shall begin to lecture, and the book which he lectures on first shall conform to the books on which lectures should be*

given, and neither he nor others shall give rambling lectures but well assembled and orderly ones with expositions and questions, if he can find them, namely the book of "Aphorisms" for 70 lectures, the "Tegni" for at least 50, the "Regimen of Acute Diseases" for 38 lectures, the "Prognostics" for 36, the book of Johannitius for 30, the entire "Viaticum" for 70 – and anyone wishing to lecture on the seventh book of the "Viaticum" for half a course shall deliver at least 20 lectures – the "Universal Diets" for 34, "Particular Diets" of the same for 26, the "Urines" of the same for 24, the "Urines" of Theophilus for 14, the "Urines" in verse of Egidius for 20 lectures." [9]

A real detailed and almost modern in shape syllabus of a course in astronomy is printed by Antonio Favaro in *"Amici e corrisponenti di Galileo Galilei: XXXI. Bonaventura Cavalieri"*. A short extract from the syllabus of Professor Cavalieri's course given during 1642-4 at the University of Bologna follows: "November. 5. Will be held the introductory lecture to the doctrine of the planets, and their sublime estate among the bodies of the universe will be shown. 7. Astronomy will be defined and divided into the doctrine of the sphere and the theory of the planets. 8. Further facts of the theory of the ten circles of the material sphere will be explained. 10. The accidents will be expounded which are connected with the aforesaid starry circles. 13. It will be explained what the Theory of the Planets is, what its object, what its divisions and what their order. Moreover, there will be shown to be three, that is to say, hypotheses, particular theories and the passions following the same. 14. The first hypothesis of theory will be set forth, namely: that the celestial movements are circular and regular. 15. The second hypothesis will be explained, forsooth: that there are two movements in the sky, that is to say, the daily movement and the movement proper to every planet. 17. The third hypothesis will be shown, namely: that the celestial movements, although they appear irregular, nevertheless will be reduced to regularity by means of eccentric circles and epicycles. 18. The fourth hypothesis will be declared concerning the construction of the universe according to the theory of Ptolemy. 19. A fifth hypothesis will be brought forth concerning the construction of the universe according to Copernicus. 22. A sixth hypothesis will be explained concerning the construction of the universe according to more recent astronomers and especially the theory of Tycho..." [10] The text continues describing the lectures to be presented in December of 1642, and then during the following two years.

Acquiring knowledge from practice or the importance of training practical skills

There is one distinct feature of natural sciences and medicine: their theories and concepts are, unlike those of the humanities, largely based on and supported by experimentation. Although the importance of the experiment was

not fully appreciated until the time of Francis Bacon or even of Isaac Newton, it should be noted that experimental work was occasionally included in science, and particularly medical science curricula in the middle ages. The law of Frederick II part of which was cited (*vide supra*) can serve as evidence that students of medicine were taught practical skills. Here is another excerpt from the law: "*No surgeon shall be allowed to practice, unless he has a written certificate, which he must present to the professor in the medical faculty, stating that he has spent at least a year at that part of medicine which is necessary as a guide to the practice of surgery, and that, above all, he has learned the anatomy of the human body at the medical school, and is fully equipped in this department of medicine, without which neither operations of any kind can be undertaken with success nor fractures be properly treated.*" [3]

Illustrative materials, in addition to textbooks are essential in science education and this was perhaps appreciated as early as the 14th century. One of the most respected medicine and anatomy teachers was Mondino, who was active at Bologna. His lessons were not only composed of reading and discussions but also included a great deal of demonstrations as well. A young woman, Alessandra Giliani of Pirisceto (near Bologna), was Mondino's assistant and was very involved in the preparation of demonstration materials. The *Cronaca Persicetana*, cited by Medici in his *History of the Anatomical School at Bologna* describes the care Giliani took to prepare the materials needed in the lectures: "*She became most valuable to Mondino because she would cleanse most skillfully the smallest vein, the arteries, all ramifications of the vessels, without lacerating or dividing them, and to prepare them for demonstration she would fill them with various colored liquids, which, after having been driven into the vessels, would harden without destroying the vessels. Again, she would paint these same vessels to their minute branches so perfectly and color them so naturally that, added to the wonderful explanations and teachings of the master, they brought him great fame and credit.*" [11]

Additional supporting evidence that experimental work was included in the science curriculum at a very early period can be found in the book *Chirurgia Magna* composed by one of the leading fourteen-century surgeons Guy de Chauliac. He describes the anatomy classes given by his master, Bettrucci of Bologna with these words: "*The dead body having been placed on a bench, he used to make four lessons of it; in the first, the nutritional portions were treated, because they are so likely to become putrefied; in the second, he demonstrated the spiritual members; in the third, the animate members; in the fourth, the extremities*" [12]. To de Chauliac the "hands-on" experience was evidently of great significance in medical education; he points out that: "*In the bodies of men, of apes, and of pigs, and of many other animals, tissues should be studied by dissections and not by pictures, as did Henricus, who was seen to demonstrate anatomy with thirteen pictures.*" [13] Curiously, this last criticism

can be seen as an early example of “rational methodology of education”.

Science Education and Curricula in Medieval Asian Countries

The idea of prescribing the suitable textbooks put in a fixed timeline of study was not exclusive to the early European universities. By examining some Asian texts, it becomes apparent that the educational institutions in this continent also had their own curricula. It is lamentable that only a handful of ancient and medieval texts from the near and far East are available for the western scholar in translated form. Nevertheless, some texts are at hand that illustrate the rules in science (especially in medicine) education in some Asian countries. The oldest known Japanese medieval collection of laws is named *Taihoryo* (702-18 AD). It was used (with some modifications) up to 1868 and strongly influenced the legal systems of neighboring China and Korea. Chapter XXIV is dedicated to the study and practice of medicine and is of significant interest for the historian of education. It prescribes not only the compulsory texts and subjects of study, but also the order by which those should be studied by the scholar of medicine. Notably, the text greatly resembles the curricula from European universities presented above, yet it is several centuries older. Herein we provide an excerpt of the laws outlining the curriculum (the phonetic rather than the translated titles of the textbooks are given here due to the absence of a more adequate translation):

"[§3] The students of medicine and acupuncture should study the classical works separately. The physicians should study [from the Chinese books]: Tziai (jp. Koiti), Motzin (jp. Myakukyo), Benhao (jp. Hondzo), as well as Syaopinfan (jp. Syobonho) and Tzianfan (jp. Syugenho)... [§4] The students of medicine and acupuncture should, at the beginning of their studies, read "Bentzao", "Motzyue", and "Mintan". While reading "Bentzao" the students should learn about the types and characteristics of medicines. When they read from "Mintan", looking at the pictures, [the students] should learn about the position of nerves. During the reading of "Motzyue", they... should study the blood pressure in blood vessels. Then they should read "Sooven", "Hwandi Chentzin", "Tzyai", and "Motzin". They should always work hard... [§5] When the students of medicine have read the classical works, they should start studying separately. For instance, out of 20 people, 12 should study therapy, three — surgery, three — pediatry, and two — [diseases affecting] the ears, eyes, mouth, and teeth. Each group should concentrate on their own major subject... [§8] The studies of therapy should be completed within seven years; those of pediatry and surgery should take five years; and for the [physician] treating illnesses of the ears, eyes, mouth, and teeth, the studies should be finished in four years. For acupuncturists the studies should be completed in seven years. After the courses of study have been completed, the best experts... should carry out thorough exami-

nations. The results from the theoretical and practical examinations should then be reported in detail..." [14]

The purpose of the present article was not merely to compile several texts related to the early "organized education", but rather to remind the reader of the significance of the curriculum in education (which was clearly appreciated as early as 8th century in Asia and 13th century in Europe). Hopefully, the examples provided here will inspire contemporary teachers and motivate them to carefully and logically arrange their lessons in order of increasing complexity of the subject. Another important issue to be considered by educators is to dedicate the appropriate amount of time to each topic (alas, time is always limited and we have to make the best use of it!). No doubt, the ancients can teach us a great deal in this respect.

References

1. **Daly, L. J.**, *The Medieval University 1200-1400*, Sheed and Ward, New York, 1961
2. **Cobban, A. B.**, *The Medieval Universities: Their Development and Organization*, Methuen & Co., London, 1975
3. *J. Am. Med. Assoc.*, 50(5), 388 (1908)
4. *Chartularium Universitatis Parisiensis*, I, 516-18, 1270-4, cited in Thorndike, L., *University Records and Life in the Middle Ages*, Columbia University Press, 1944, p. 81
5. **Reeds, K. M.**, *Botany in Medieval and Renaissance Universities*, Garland Publishing, Inc., New York & London, 1991, p. 42
6. **Walsh, J. J.**, *The Popes and Science*, Fordham University Press, New York, 1911, p. 416
7. *Chartularium Universitatis Parisiensis*, III, 143-6, 1366, cited in Thorndike, L., *Op. Cit.*, pp. 246-7
8. **Malagola**, *Statuti*, rubric 68, pp. 274-6, cited in Thorndike, L., *Op. Cit.*, pp. 279-82
9. **Fournier**, *Les Statuts et Privileges*, III (1892), 167, cited in Thorndike, L., *Op. Cit.*, p. 321
10. **Thorndike, L.**, *Op. Cit.*, pp. 393-405
11. **Walsh, J. J.** *Old Time Makers of Medicine*, Fordham University Press, New York, 1911, pp. 226-7
12. **Walsh, J. J.** *ibid.*, pp. 288-9
13. **Walsh, J. J.** *ibid.*, pp. 275
14. *Svod Zakonov "Taihoryo"*, 702-718 gg., *XVI-XXX Zakony (The Collection of Laws "Taihoryo"*, 702-718, *Laws XVI-XXX*, in Russian), Nauka, Moscow, 1985, pp. 99-100

ОБРАЗОВАНИЕ И УЧЕБНИ ПЛАНОВЕ В РАННИТЕ УНИВЕРСИТЕТИ – НЯКОИ ДОКУМЕНТАЛНИ СВЕДЕНИЯ

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