

XML as an Educational Curriculum Presentation of a Case Study

MENYHÁRT László Gábor

Abstract. XML can be found in all areas of information technologies. However, there is no such prevalence in education. In this article, I present the result of my case study in which I checked how XML and related technologies appear in education. The research was on the Internet and it processed several Hungarian and almost the same number of foreign universities' curriculum in English and German languages.

Keywords: case study, education, curriculum, Internet, XML

1. Introduction

Computer users can be grouped so that there are end-users and professionals. End-users use the computers for Internet, e-mail, office works and playing. Those professionals are less who use computers even more developing, operations or they can use computers lower level.

End-users do not meet XML directly, but they do not know any other file format either. However, these files appear on their computers, namely XHTML file can be seen in browser and at this time an XML file is downloaded into their computer. When they save an Office file like with *docx*, *xlsx* or *odt*, *ods*, etc. file extensions, these compressed files contain a directory structure with XML files storing configuration and data. Latters' format is OASIS Open Document Format (ODF) [7], former is Microsoft's own Open specification based on ODF and Open XML (ECMA-376 and ISO/IEC-2950). [8, 9]

So, if users do not see XML format directly, it appears in low level in a lot of places like configuration, storing data and communication. It used in many places. Here are some examples:

1. Configuration of webservices (domain.xml, ...)
2. Configuration of applications (web.xml, ...)
3. Configuration of operations like logging (log4j.xml, ...)
4. Storing data in applications like Hungarian national tax and customs' general form filter application (Általános nyomtatványkitöltő program (ÁNYK)) uses *enyk* files with XML snytax, or UML diagrams are also XML files after saving, these are XML Metadata Interchange (XMI) files [10]
5. Data transfer with web-services (standard WS with SOAP)
6. Flexible using between versions, structure of XML allows to access part of data and ignore others.

So, XML is a good tool for integration between different systems.

I might highlight that big database systems like Oracle and DB2 types were developed to manage XML and special SQL syntax is available for filtering data with XML type. [11, 12, 13, 14]

At the same time development of native XML databases is started. [15, 16, 17] There were more experiments to implement one but only few stayed alive. Sedna's [18] last version (3.5) was published in November 2011, eXistDB' [19] version 3.0 can be downloaded from July 2015, Apache stopped development of xIndice in August 2011, after 10 years. Oracle bought Berkeley DB and its version 6.0.17 is available (though its documentation was updated in December 2009 for version 2.5.16 [20, 21]).

2. The case study

As we saw in the introduction, XML can be found in all part of informatics. But it has not so wide penetration in education.

In a case study the executor does the next steps: asks questions, selects the cases, decides about the technic of the data collection and analysis, collects data, evaluates and analyses them finally creates report. Case study is linear; it does not give changing proposal for handling possible problems founded at analysis of collected data. It gives only report. [23]

In this article I present the information about XML curriculum found in the research of education organizations. Results of my data collection in raw is available on link [1]. I explain in text here what I found when I researched where and how XML is taught. References are available in appendix in detail, so these are not mentioned here.

Method of data collection was online research, so it contains that information that is published via Internet, available and found by me. Google was used as starting point, at first free text search was used, later thematic search was run on sites of universities and filtering the pages. List of links contains every starting page. When searching in databases of the sites was available, I continued it there. Reading detailed descriptions and curriculums happened, too. I indicated the topic with “X” in the table in the appendix when it was mentioned exactly, and with “?” when it was not definitely written but affected most likely.

2.1. Hungarian institutions

At first, I investigated online published data of Hungarian universities.

XML Markup Language is available between programming languages on portal maintained **Eötvös Loránd University**'s (ELTE) Department of Programming Languages and Compilers. It appears on more courses like “Design, implement and manage databases” (IP-abATME/1), “Modern databases” (2+2) (IPM-08irKAEG/1) and “Theoretical foundations of information systems”. Latter's thematic does not mention, only the available matters. Relevant topics are different and do not cover full palette. There is one more special collegium about XML, I will write about this in one of the following paragraphs.

There are more courses on **Budapest University of Technology and Economics** (BME) dealing with XML and related technologies. For example: XML-based system integration in business, XML and applications, The basics of XML. There are some between the university's normal courses, but some is started only on higher level vocational training. So, topics and quality of education can be different.

“XML programming” course was on **University Pannonia** Faculty of Information Technology in spring semester 2008/09. It taught XML, DTD, DOM processing and XSL transformation. Because of XSL materials should contain XPath, too. It seems that this course was available on spring semester 2011/12 for the last time. But course “Web programming” is available from 2008, where XML, XSD and XSL is part of the materials. XML is mentioned in courses „Electronic business technologies” and „Methods of modern system development”. Bilicki Vilmos' materials about XML, XSD, DOM and XPath are for the course „Development of program systems”. Holló Csaba's materials about XML, DTD and DOM are for course „Business web technologies”.

Topics of “Database based systems” course on **University of Szeged** contains XML, DTD and native XML databases. I found only the first two in a lecture notes, but it does not mean that native XML databases were missed. Maybe there is another independent lecture note and it is about

XQuery, as well. XML is mentioned in courses “Application development”, “Information technologies”, “Web content development”, “Business web technologies” and “Advanced programming II.”. Bilicki Vilmos’ course “Development of program systems” is available here, too.

XML can be found in a lot of description of courses on **University of Debrecen** Faculty of Informatics. It is negotiated in course “Programming technologies”. “HTML, XML” pays attention on XSD, XPath and XSL. Course “XML data management” presents XSL, XSL-FO and XQuery, as well. „Advanced database technologies” teaches XQuery, too. Jeszenszky Péter’s „Advanced XML technologies” presents XSD, XPath and XSL.

XML is present in course “Software technology I.” on **Corvinus University of Budapest**. DTD, XPath and XSL are presented in course „Network technologies II.”. Course „Internet application development” contains more, it teaches the previous ones and XSD.

XML is in professional and examination requirements of tertiary qualifications of Web-programmer training on **Budapest Business School** (BGE) University of Applied Sciences.

On the websites of **University of Dunaújváros** XML can be found in materials of courses „PERL” and „Web programming”. But course “Internet technologies”, available on engineer informatics basic training and Web-programmer advanced vocational training, deals with DTD, XSD, XPath and XSL topics in detail.

Course “Data management with XML” on **University of Miskolc** Faculty of Mechanical Engineering and Informatics processes DTD, XSD, SAX and DOM, XPath, XSL and native XML databases, XQuery topics in detail.

On **University of Nyíregyháza** the course “XML” of program designer informatics presents XML, SAX, DOM and XSL, so XPath, too. In teacher training the course „Applied systems” mentions XML, XSD and translations, which is probably XSL. In higher level vocational training XML based technologies is mentioned at „Related professional practice”, and some books with XML topic is listed as recommended literature to course „Internet tools and services”.

XML is mentioned only in course “Programming web systems on server side” on **University of Sopron**’s Web-programmer and General administrator Higher level vocational training, but course „ Programming web systems on client side” mentions XML, DTD, XPath and XSL, too.

Óbudai University’s course „Theory and practice of database management” teaches XML topics in detailed, like XML, DTD, XSD, XPath, XSL and XQuery. Another course „Web-based technologies” teaches XSL-FO instead of XQuery, and XSD is not mentioned.

Websites of **Neumann János University** – earlier Pallasz Athéné University – contain XML at courses „Corporate Information Systems I.” and „WEB-programming II.”. Native XML databases are available on course „Databases II.”. XML and native XML databases are mentioned in course „Visual programming”.

XML, DTD, SAX, DOM, XPath and XSL are present on course “Basics of Language Technology” on **Pázmány Péter Catholic University**.

On **Széchenyi István University** course „WEB-technology 1” deals with XML and DTD.

Some XML training material is available on websites of **Free Information Society** and Bíró Szabolcs’ curriculum “Text processing based on XML” can be found on **Tankönyvtár**.

2.2. Foreign examples

I was able to process only English and German web pages from foreign universities. I chose some universities from the first two hundred – as standard – because of their high number.

There are more courses dealing with XML on **Massachusetts Institute of Technology**. Thematic of course „Special Problems in Architecture Studies” mentions only XML, but the downloaded materials contain DTD as well. Course „Biomedical Information Technology” teaches XML, native XML databases and XQuery. Course „6.893: Database Systems” teaches XML, native XML databases, SAX and DOM processing, too. Course „1.264J / ESD.264J Database, Internet, and Systems Integration Technologies” is the most accurate because it negotiates the previous ones and XPath and XSL.

I found two courses with XML in course list of **Harvard Computer Science**. Course „XML with Java, Java Servlet, and JSP” deals with XML, DTD, XSD, SAX, DOM, XPath, XSL and XQuery topics. Course „Web Development Using XML” teaches the previous ones and XSL-FO and native XML databases.

In the course list of **Stanford** I found four courses. Course „Callback Me Maybe: Contemporary Javascript (CS 42)” mentions XML and DOM processing. Course „XML Data” teaches XML, DTD and XSD. Course „XML and Databases (CS 345B)” last in 2007 negotiated the previous ones and XSL and XQuery. While course „Introduction to Databases (CS 145)” mentions XPath, too.

On website of **Berkeley** I did not find any course about XML in last years. But earlier between 2003 and 2005 there was a course „XML and Related Technologies” that taught XML, XSD, XPath and XSL topics. Between 2007 and 2011 course „Concepts in Computing with Data” negotiated R programming language for statistic calculations, and it mentioned XML. Between 2006 and 2013 course „XML Foundations” was about XML, XSD, XPath, XSL and XQuery.

On **Oxford** a course „Extensible Markup Language” was found that presents XML, XSD, XPath and XSL topics.

In the course list of **University of Toronto** I did not find any course that negotiate XML.

In the course list of **University of British Columbia** I found only one course „Introduction to Database Systems” between 2005 and 2016 which mentions XML, XPath and XQuery.

XML, DTD and XPath are present in material of courses „Using R for Data Analysis and Graphics” and „Programming with R for Reproducible Research” on Swiss **Eidgenössische Technische Hochschule** (Zürich). Probably SAX, DOM and XSL should be negotiated. Not only the materials of Department of Statistics about R programming language contain XML, DTD, XSD, XPath and XQuery, but these are present in materials of the course “Big Data” since 2012, as well. Unfortunately, other and newer courses are not available in public.

On websites of the Australian **Monash University** I found materials of the course „Information retrieval systems” between 2006 and 2008 with code CS3201. XML, DTD, XSD and XSL was present, but XPath must be taught as well. I was unable to check whether there were changes in the material since then because login is required, and code was changed to FIT5166.

The University of Sydney ‘s course „E-Business Engineering” in 2007 has material via Internet with code COMP5347. This contains XML and XSL, but probably XPath, DTD and XSD is touched. Material of course „Foundations: Internet Software Platforms” (ELEC5742) contain XML and DTD.

Websites of **National University of Singapore** mention XML, but unfortunately, I did not find any material via public Internet to prove the appearance in education.

From Germany I checked materials of **Freie Universität Berlin** at first, where the materials are public only before 2008. Thematic of course “Datenbanksysteme II” mentions XML and DTD, but the materials are about SAX, DOM, XPath, XSL and XSL-FO as well. Thematic of course “Softwaretechnik” does not mention any part of XML topic, but XML and DOM is present in the materials. The same happened with course “Projekt Webdienste Wong - World of Networked Games”. XML, DTD, XPath and XSL are mentioned in course “Digitale Editionsmethoden”.

On websites of **Technische Universität München** I found a lot of reference to XML and related technologies. Material titled “Transformation von XML-Dokumenten” contains XML, XPath, XQuery, XSL and XSL-FO topics. Course “Einsatz und Realisierung von Datenbanksystemen” contains a topic “XML und Datenbanksysteme” that teaches XML, XPath and XQuery-t. In course “Foundations in Data Engineering” the topic “Other Data Models” negotiates XML, DTD, XSD, XPath and XQuery. Course “Database-Supported XML Processors” in year 2007/08 presented in detailed the XML topics except XSL-FO and native XML databases.

According to **Universität Tübingen**'s websites course “Database-Supported XML Processors” was available with the same content and teacher mentioned in the previous paragraph till year 2013. From onwards course “Advanced SQL” negotiate less topics.

After the universities I looked for online courses, whether how XML is educated. Starting point was a list of online courses and collection of MOOCs. For example, *coursetalk.com* contains courses from KhanAcademy, Stanford Online, Coursera, edX and other portals. XML is mentioned here in 184 courses, and 19 are free. Seven courses are rated with 4 stars out of five, 4 of them are free.

On site *open2study.com* I did not find any courses dealing with XML at the time of the search.

XML was mentioned in two courses on site *edX.org*. These are „Professional Android Developer” by GalileoX and „Supply Chain Technology and Systems” by MIT.

8 courses mention XML on *Alison*, but they are not exactly about it.

Lynda's 6 courses mention XML.

On site *Udemy* there is a concrete course about XML and XSD: „XML and XML Schema Definition in Easy Steps”, and course „Learn XML Programming” is about XPath and XSL topics, there are another 39 courses mentioned XML.

A course from site *online-learning.com* that lasts 6 weeks, needs 4 hours per week activity and costs \$ 279 is the most detailed and teaches XML, DTD, XSD, XPath, XSL, XSL-FO and XQuery.

Education materials are offered by **Association for Computing Machinery** (ACM). These are published every few years. The „Computing Curricula 2001 Computer Science” published December 2001 did not mention XML, but the „MSIS 2006: MODEL CURRICULUM AND GUIDELINES FOR GRADUATE DEGREE PROGRAMS IN INFORMATION SYSTEMS” version from 2006 contains „IT Infrastructure (Level 2)” where the webservices deal with XML. The „Information Technology Curriculum Guidelines for Undergraduate Degree Programs in Information Technology” published in 2008 contains „Information Management (IM) Data Organization Architecture, Managing the Database Environment, Intersystem Communications, Data Mapping and Exchange” and „Web Systems & Technologies” topics where XML, DTD, XSD, SAX, DOM, XPath and XSL technologies are listed. At the same year another publication, „Computer Science Curriculum 2008” mentions XSD as well in topic „Information Management

DataModelling”. The same publication from year 2013 has two other topics „Data Modeling” and „Introduction to Databases” where XML, DTD, XSD, XPath, XSL and XQuery are present, too.

3. Presentation of my course „Data handling – XML”

In the previous paragraph I wrote about where and how XML is taught. IN this section I present my “Data handling – XML” course available on ELTE as a special collegium with IKI-AXFG and TANM-INF-300-XML codes. I teach this with my own thematic and materials since spring semester 2002/03.

At first it starts as an optional block on teacher training program, but software designers signed up in 50-50%. The aim of the course is to recognize databases and their integrated environment. At that time on the teacher trainer program’s students had 2+2 (later 2+3) lessons per week with databases, this timing is not enough to know databases in proper depth, because this knowledge is important nowadays. Because of the high prevalence of W3C standards and semantic WEB we selected the XML technology to show the students formal and formatted data. So, the students learned markup languages for a semester. They learned about possibilities of storing method in semi-structured databases. They learned about native XML databases and XML type extensions of relation model.

The condition of practical mark is to present an assignment in XML topic and write a test at least with adequate qualification.

Topic contains the followings: representation of databases, description of data, XML syntax and well-formed definition. Constraint data with document type definition (DTD), schema (XSD Schema) and validation. Programming possibilities like SAX and DOM. Addressing data members with Xpath. Transformation of XML document (XSL, XSLT), formatted appearance (even in PDF). Native XML databases, for example Xindice. The detailed thematic per weeks:

1. Representation of databases, description of data, syntax, introduction of XML based on HTML knowledge, with attention regard to syntax and well-formed property
2. Document Types Definition: its syntax and validation (DTD)
3. XML Schema syntax and validation (XSD)
4. Presentation of Simple API for XML and Document Object Model with Javascript or Java
5. Comparing SAX and DOM, using them in different cases
6. Query languages, addressing nodes of XML document. Syntax and functions. (XPath)
7. Different style definition possibilities, XML Schema language’s grammar and functions (XSL)
8. Transformation on client and on server side with XML Schema Language (XSLT)
9. Presentation of a native XML database, Xindice. Installation, administration
10. Handling XML data in Xindice. Using query languages in practice, XPath examples
11. XML:DB, Usage of XUpdate
12. Application of XML document, usage with different technologies: JavaScript, Java, JSP, PHP
13. Test
14. Presentation of assignments, replacement of tests if necessary, administration

We specified [24], [25], [26] and [27] as recommended literature beyond the next links: [28], [29], [30], [31], [32], [33] and [34].

Structure of a 90 minutes lesson per week is the next: the first half part is an interactive presentation about the new knowledge, the second practise part is for solve the sample tasks.

The new technologies learned in this semester must be used and presented in the assignment task. The test stands in two parts. First half an hour is the theoretical part, when concepts, differences and relationships are written on paper. Next on the practise part looking for mistakes correction and create new functions are the tasks on computer in his topic. Link [2] contains an example test.

Students' feedback shows that they like the subject and have learned interesting and useful things. Some feedback is available on links [3], [4], [5] and [6].

4. Conclusion

My curriculum about XML and related technologies can be shown at the early stage of the current informatics training on universities and later students can build their learning knowledge on this.

Previous paragraphs show that XML can be found in a lot of universities' curriculum. Somewhere there is only some lessons about XML in a course, elsewhere there is a whole course about XML. In some places it is mentioned as a data representing model, but sometimes it is compared with structured databases.

Teaching XML is inescapable today's informatics training found with a lot of my colleges, because it is mentioned more times, compared with other technologies, and some is based on this. But XML is not present between the mandatory foundation courses.

Teaching another, „Web-development” course realized that XML could be good at an early stage on the university. So, courses could build onto this and could use the concepts and methods if there is an introductory course about XML.

My curriculum is designed for a semester and it is one of the most extensive study materials which present the structured data and types. It introduces the world of text files, sequence processing and tree data structure in the memory. It encourages abstract, higher-level thinking through configuration constraints.

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Author

MENYHÁRT László Gábor

Eötvös Loránd University, Faculty of Informatics, Department of Media and Educational Informatics, Hungary,
e-mail: menyhart@inf.elte.hu

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