

Who's Who in High School Computer Science Textbooks in Taiwan

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Abstract

The scientists mentioned in textbooks are those who had great contribution to the field. By learning about the life and the societal and cultural background of scientists, students learn not only science knowledge but also how science interacts with human life. This study examines how computer scientists presented in the high school computer science textbooks in Taiwan. A total of 13 high school computer science textbooks are analyzed. The analysis results show that: (1) The most mentioned computer scientists in the textbooks are Linus Torvalds, followed by Dennis Ritchie and John von Neumann; (2) the most computer scientists mentioned is in the field of Programming, followed by hardware, software and operating systems; (3) the time that computer scientists are most mentioned is after 1946, when the digital computers were invented, followed by the era before 1900s; (4) the descriptions of computer scientists are usually brief and focus on their contributions to the fields. Curriculum guidelines and the preferences of the authors are the main factors affecting the presentation of computer scientists in the textbooks.

Keywords: computer science, computer scientist, textbook

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Introduction

Textbooks are used in the majority of science and mathematics classrooms (McDonald, 2016; Banilower, Smith, Weiss, Malzahn, Campbell & Weis, 2013). Many scientists are presented in textbooks. Introducing the contribution and the life of scientists help students learn not only science knowledge but also how science is developed. It also brings the human factor into the learning of science and technology. Miller (1988) indicated that the societal and technical aspects of computing are interdependent, and technical issues are best understood and taught in their social context. By learning about stories of computer scientists, even non-science majors can be more engaged in the study of computer science.

It is important to know how scientists are presented in textbooks. Science textbooks influence students' image of science and scientists, and students very often draw images similar to what their science textbook presented (She, 1995). Students' views of scientists' images affect their willingness to engage in science-related work (Mason, Kahle, & Gardner, 1991). Analyzing how scientists presented in textbooks may reveal information on how students acquire image of science and scientists, even how science was understood.

Computer science textbook in Taiwan are endorsed by the Ministry of Education. The textbooks must follow the curriculum guideline set by the Ministry of Education. The first high school computer science curriculum in Taiwan launched in 1984, followed by major revisions in 1995, 2008, and 2017. The present 2017 CS curriculum is required for Grades 7-9 and Grade 10 students. The course credits are 6 credits and 2 credits respectively. The content areas for students to learn include programming, algorithms, system platforms, applications, data representation and analysis, human and social issues. This study attempted to analyze how computer scientists were presented in high schools CS textbooks in Taiwan. We were interested to know, for example, the most commonly mentioned computer scientists, the field has most computer scientists mentioned, the factors affecting the presentation of computer scientists, and how computer scientists were presented.

Purpose

The purpose of this study was to analyze computer scientists presented in Taiwan's high school computer science textbooks. The research questions are as follows:

- (a) Who are the most mentioned computer scientists in the textbooks?
- (b) Which field of CS has the most computer scientists mentioned in the textbooks?
- (c) What factors affect the presentation of computer scientists in the textbooks?
- (d) How computer scientists are presented in the textbooks?

Method

A total of 13 high school CS textbooks across three versions of curricula were analyzed, including five textbooks with 1995 curriculum, four textbooks with 2008 curriculum, and four textbooks with 2017 curriculum. The content analysis method was applied in this study. All the textbooks were reviewed and the content related to

computer scientists were identified, and then the identified contents were categorized to answer the research questions.

Results

1 The Most Mentioned Computer Scientists

We calculated the number of textbooks that a computer scientist was mentioned. No matter how many times a scientist was presented in different part of a textbook, the number of times was one. Table 1 provides the computer scientists, who were mentioned at least in three textbooks, and their major contributions addressed in the textbooks. The most mentioned computer scientists were Linus Torvalds, followed by Dennis Ritchie and John von Neumann. The most mentioned computer scientists are related to the design of computers (John von Neumann, Blaise Pascal, Charles Babbage, and J. Presper Eckert), the development of hardware and system (Linus Torvalds, Gordon Moore, Herman Hollerith, Tim Berners-Lee, and Vint Cerf), and programming languages (Dennis Ritchie and Grace Hopper). The result revealed that the history of computer science was usually the core portion that computer scientists were presented.

Chen and Wu (2013) asked CS teachers to nominate important computer scientists that students need to know, and the top five people were Bill Gates, Steve Jobs, John von Neumann, Tim Berner-Lee, and Steve Wozniak. Among them, Bill Gates (2 textbooks), John von Neumann (6 textbook), and Tim Berner-Lee (3 textbooks) are appeared in both lists. It seems what CS teachers had in mind is different from the textbook authors, or different from the focus of the curricula. However, everyone agreed the importance of John von Neumann.

Name	N	Main contribution
Linus Torvalds	8	Designed Linux OS
Dennis Ritchie	6	Improved B language to C language
John von Neumann	6	Proposed the stored-program architecture
Blaise Pascal	4	Designed mechanical calculator-adder Pascaline
Charles Babbage	4	Invented the Difference Engine and the Analytical Engine designed with modern computer operation concepts
Gordon Moore	4	Presented Moore's Law, Co-founder of Intel Corporation
Herman Hollerith	4	Invented a card reader to read card information. Calculators had evolved from the mechanical age to electrical appliances, and computer technology had also evolved since then.
Ada Lovelace	3	Worked with Babbage to study the instructions to operate the Analytical Engine Become the first programmer by later generations

J. Presper Eckert	3	Mauchly and Eckert make the world's first computer ENIAC with a vacuum tube
Grace Hopper	3	Invented the world's first compiler-"A-0" Created the first commercial computer programming language COBOL
John Mauchly	3	Mauchly and Eckert make the world's first computer ENIAC with a vacuum tube
Tim Berners-Lee	3	Developed the World Wide Web (WWW)
Vint Cerf	3	Proposed a set of communication protocols TCP/IP presenting the concept of the Internet

Note. N: the number of textbooks mentioned

Table 1. The Most Mentioned Computer Scientists in Textbooks

2 Fields with the Most Computer Scientists Presented

To know which field has the most computer scientists presented, we counted the number of computer scientists mentioned in each field. If a computer scientist's contribution includes more than two fields, each of the field is counted once. The ten fields listed in Table 2 were the learning content outlined in the three versions of the CS curricula. Table 2 revealed the number of computer scientists mentioned in each field. The result showed that the field of programming had the most computer scientists mentioned, followed by computer hardware, and then software/operating systems.

Programming has received unanimous attention from the Computer Science educators around the world in recent years. Programming was emphasized in all the three versions of high school computer science curricula. The result responded to the situation where programming had received much attention.

Fields	N			
	1995's	2008's	2017's	Total
Programming	19	11	2	32
Hardware	3	20	1	24
Software/ OS	3	6	1	10
AI	0	2	7	9
Network	1	6	2	9
Other application	1	5	2	8
Algorithm	0	2	5	7
Logical operation	1	1	0	2
Block Chain	0	0	1	1
Information security	0	0	1	1

Note. N: the number of computer scientists presented

Table 2. Computer Scientists Presented in Each Field

3 Time with the Most Computer Scientists Mentioned

To understand which period of the time had the most computer scientists mentioned, we categorized the contributions of scientists into three periods, which were the 19th century and before, between 1901~1945 (before the invention of digital computer), and post-1946 (after the ENIAC computer was invented). The findings showed that the period after 1946 had the most computer scientists mentioned, with a total of 45 counts; followed by the time before the 1900s, with a total of 8 counts; and only 2 mentions were made on scientists between 1901 and 1945. The result showed that the textbooks were most likely to present computer scientists who made contributions after the invention of computers. The reason may be due to that more inventions and progress of computer science occurred after computers invented. Another possible reason was that the history of computing was not a major portion of the computer science curricula, thus computer scientists in early times were of less importance.

4 Factors Affect the Presentation of Computer Scientists

To identify the factors affecting the presentation of computer scientists in textbook, we analyzed the number of computer scientists mentioned in each textbook. The statistics presented include the average number, the total number, and frequency of mentions of computer scientists in textbooks with different curriculum guidelines.

Table 3 showed the number of computer scientists presented in each textbook. The results showed that the textbooks of 2008 curriculum had the most computer scientists presented, with an average of 16 scientists presented in each textbook; followed by the textbooks of 1995 curriculum, with an average of 7.8 scientists in each textbook; and the textbooks of 2017 curriculum presented the least computer scientists, with an average of 5.8 scientists. Because the history of computing was a part of the 2008 curriculum, the textbooks usually presented the content with the contributions or the stories of computer scientists. The textbooks of 2017 curriculum presented least computer scientists, the reason may be that history of computing was withdrawn from the curriculum. The different emphasis of curricula would result in different presentation of computer scientists in textbooks. Table 3 also showed that different authors presented computer scientists differently, especially in the 1995 curriculum. Three of the textbooks presented less than five scientists, while as two of them presented more than 14 textbooks.

	1995 curriculum						2008 curriculum					2017 curriculum					
	A	B	C	D	E	total	H	I	J	K	total	L	M	N	P	total	total
N	3	14	5	16	1	7.8	16	16	12	20	16.0	7	6	7	3	5.8	9.7

Note. N : the number of computer scientists

Table 3. The number of computer scientists presented in each textbook

Table 4 showed the introduction of the top three computer scientists in each textbook. Linus Torvalds and Dennis Ritchie were commonly mentioned in both 1995 and 2008 curriculum but none in the 2017 curriculum. John von Neumann appeared in most textbooks of both 2008 and 2017 curriculum but none in the 1995 curriculum. In

addition, only two counts of computer scientists were found in the textbooks of 2017 curriculum. The focus of curriculum may address the difference of presenting computer scientists.

Name	N	1995 curriculum					2008 curriculum				2017 curriculum			
		A	B	C	D	E	H	I	J	K	L	M	N	P
Linus Torvalds	8	✓	✓	✓	✓	✓	✓	✓	✓					
Dennis Ritchie	6		✓	✓	✓		✓	✓		✓				
John von Neumann	6						✓	✓	✓	✓	✓	✓		

Note. N : the number of textbooks

Table 4. Distribution of the top three Computer Scientists mentioned in textbooks

Table 5 show that the most mentioned computer scientists in the textbooks of 1995 curriculum were Linus Torvalds, Dennis Ritchie, and Bill Gates. The 1995 curriculum emphasize introduction of computer science and programming, thus these three computer scientists are presented. The computer scientists most mentioned in the textbooks of 2008 curriculum were Blaise Pascal, Charles Babbage, and Herman Hollerith, who were all in the days before computers invented. Due to the emphasis on the history of computer science in the 2008 curriculum, the textbooks focused on computer scientists who have made significant contributions on the invention and application of digital computers. The computer scientists commonly mentioned in the textbooks of 2017 curriculum were Edsger Dijkstra, John von Neumann, and Leonhard Euler.

Name	N	Main contribution
1995 curriculum		
Linus Torvalds	5	Designed Linux OS
Dennis Ritchie	3	Improved B language to C language
Bill Gates	2	In 1975, Bill Gates and Paul Allen developed the BASIC compiler; founded Microsoft Corporation
2008 curriculum		
Blaise Pascal	4	Designed mechanical calculator-adder Pascaline
Charles Babbage	4	Invented the Difference Engine and the Analytical Engine
Herman Hollerith	4	Invented a card reader to read card information. Calculators have evolved from the mechanical age to electrical appliances
2017 guideline		
Edsger Dijkstra	2	Proposed the concept of Structured Programming

John von Neumann	2	Proposed the stored-program architecture in 1945
Leonhard Euler	2	Started graph theory research

Note. N: the number of textbooks mentioned

Table 5. Computer scientists presented in each of the three curricula

5 How Computer Scientists Were Presented in Textbooks

We found common characteristics which the textbooks presented computer scientists. Computer scientists in the textbooks are usually presented in a short and straightforward way, often describe plain facts such as “Android was originally developed by Andy Rubin”, “Bill Gates and his good friend Paul Allen developed the BASIC compiler”, and “Berners-Lee proposed the WWW plan, which later became a major service on the Internet”. These descriptions presumably are due to the limitation of the textbook volume that textbook authors can only describe computer scientists in a concise and simplified way. The other reason is that the authors did not realize the importance of presenting computer scientists to students.

Some presentation of computer scientists tends to be knowledge-driven. They often introduce computer scientists using special terminologies. For instance, “Linus Torvalds is not satisfied with the Minix operating system, which is similar to UNIX. So in 1991 he published on the school FTP his work called Freax, as the kernel of Linux. This is a combination of free and freak, and the letter X is used for the Unix-like system ...” Descriptions like this are full of jargon and lack humanistic elements, and may make students feel bored in reading.

Conclusion

Introduction of computer scientists is an idea way to present science knowledge and scientific enterprise to students. It also adds humanistic ingredients into learning and teaching.

The findings of our study showed that Linus Torvalds, who designed Linux OS, was the most mentioned computer scientist in the textbooks; computer scientists were most mentioned in programming languages related content; computer scientists were most mentioned after digital computers were invented in 1946; presentation of computer scientists were affected by the authors and the focus of curriculum; and description of computer scientists were often short, plain, and fragmented.

We also found that computer science textbooks, due to the limited space, may not give a comprehensive introduction of computer scientists, or simply mention their contributions briefly. The key factors for presenting computer scientists in textbooks may depend on the focus of a curriculum and the preference of textbook authors. It is recommended computer science curriculum to address the importance of presenting computer scientists and textbook authors to realize the positive effects on introducing computer scientists in students’ learning.

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