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AN COMPARATIVE STUDY ON INFORMATICS CURRICULUM : FOCUSED ON KOREA, UNITED STATES, AND UNITED KINGDOM

Abstract:

Since the importance of software in society, software education has been globally introduced. Korean government is also trying to promote talents by the revision of curriculum; however, due to the lack of lesson hour, education course is not enough to foster sufficient software focused talents. Thus, by supplementation of present curriculum, the development of new curriculum model has been needed. In this study, as a basic research of this development of curriculum model, curriculum revised in 2015 of Korea was compared with that of U. S. A. and that of England. Through the comparison, it was possible to find out what is needed to make up for informatics curriculum. This result could be used as an advanced research for the development of software curriculum model with Korean education context.

Keywords:

computer science curriculum, comparative study, International Study, secondary school curriculum

JEL Classification: I21, I29

Introduction

As science and technology has been surprisingly developed, the advancement in the technology of computer science has been accentuated. Therefore, the latest technology as machine learning, artificial intelligence and big data started to grow and these technologies adapted to software has promoted the progress of diverse industries and studies. As the application of software in various field, it has been more important to foster talents who can cope with problems with software. Thus, it has been increasingly insisted that software competency should be taught in school (Han & Kim 2015).

Therefore, software education started to be applied in curriculum globally. In many states of United States. Programming education has been conducted focusing on CSTA K-12 Computer Science standards that is developed by the Computer Science Teachers Association (CSTA) (CSTA 2011). In United Kingdom, present curriculum which was focusing on ICT technology has been revised so that it can concentrate on computer science (Department for Education 2013). Moreover, the education to foster software talents based on computational thinking for every student. In Finland, since 2016, programming education will be introduced (Shin & Bae 2015) and in Japan, since 2020, programming education will be instituted so that student can have more competency to develop softwares (Sung & Kim 2015). Korea also made informatics subject compulsory subject. Furthermore, curriculum has been revised to foster talents who can deal with problems utilizing computers (Ministry of Education 2015a).

Nevertheless, in Korean curriculum, the lesson hour of software education in elementary school is only 17 and, in middle school, 34 and its contents also needed to be modified to fit into this number, consequently, bounteous parts of contents have to be cut out. Teachers and researcher of computer education are saying that more number of lesson hours and contents are necessary to foster students' software competency (KICE 2015b). Therefore, the development of revised curriculum model is needed to foster software talents who are necessary for the modern society.

Thus, in this study, the basic research to suggest the direction of the Korean software curriculum model development with the comparison of foreign software curriculum, for this study, various types of curriculum were collected and analyzed to deduce the implication of curriculum model development.

Method

Research procedure

Study have been performed to redeem Informatics in Korea as follow: first, computer science curriculum of many different countries are collected. And, through the review of the experts, research subject for analysis were selected from gathered computer science curriculum in several countries. In order to derive the implications, informatics curriculum

in Korea was compared and analyzed to other curriculum. Next, Research result was conducted to examine the experts, the opinions collected through public hearings. Through this process, to modify and supplement the results of this study were further derives a final result.

Research subject

Computer science curriculum domestic and foreign is subjects for this case study. The curriculum of Estonia, finland, China, Japan, United States, United Kingdom, and India are collected through existing studies and searching Internet. Among these countries, United states and United Kingdom are selected as a research object that release detailed contents of computer science curriculum(CSTA 2011). In United states case, we take ‘CSTA K-12 Computer Science standards’ developed by CSTA as a research object. In United Kingdom contents related with computing which is included in ‘The national curriculum in England’ and ‘Computer Science: A curriculum for schools’ which is developed by CAS are research object (Computing at School Working Group, 2012; Department for Education 2013). Lastly in Korea, research object is Informatics contents in 2015 revised curriculum (Ministry of education 2015b; 2015c).

Research method

First, a comparative analysis of three countries’ curriculum have been done. Expert group reviewed these case and choosed ‘CSTA K-12 Computer Science standards’ as an analysis criteria. They explore United Kingdom and Korea case based on it. ‘CSTA K-12 Computer Science standards’ present leveled competency, practice and content, unlike United Kingdom and Korea. On the contrary, United Kingdom and Korea present contents which all students have to learn. The compare curriculum was confirmed that the achievement standards in computer science curriculum in each country based on the 'CSTA K-12 Computer Science Standards' are included. The analysis get validity by expert review. To ensure the validity, it was performed to review the experts and conduct the public hearing

Result

Level 2

Examining Collaboration (CL) part, while in United States, Technology and computing should be utilized for CL in Computer Science Education, in United Kingdom and Korea, these were not included.

Examining Computational Thinking (CT) part which is increasingly important by the development of computer science technology, problem solving and data representation

are included in both country: Korea and United Kingdom; however, in United States, the contents of algorithm, modeling and simulation, abstraction and connection to other fields include contents which are proper for middle school, high school and advanced in high school in Korea. Thus, it was possible to say that both Korean curriculum and United States. curriculum contain CT contents, while the level of each side was different. In United Kingdom, CT was Key process so the whole curriculum was designed to foster talents with CT; however, the contents of modeling, simulation, connection to other fields are not covered. Consequently, computer science curriculum in United States. Includes more contents of which level is much higher than that of United Kingdom and Korea.

Examining Computing Practice and Programming (CP) part, it was clear that each country has shown diversity in utilizing technology to make artifacts and learning. While in United States. The level was 2 and in United Kingdom, CP is not even included, in Korea, the contents of this part is appropriate for advanced in high school. The level of contents in programming in United States. And, United Kingdom is almost identical while that of Korea is much higher.

Examining data collection, analysis and information security, every country shows similar level of contents; however, the content about jobs. Shows obvious difference: In Korea, Information literacy is included so that in middle and high school, the contents about career exploration with computing is covered while in United Kingdom, the contents about jobs are not included. In CP part, CP in United Kingdom was relatively small while in Korea, entire CP contents of United States. curriculum were covered and its level was higher.

Computer Communications Devices Strand (CD) part which covers the hardware of computers and networks has not shown noteworthy difference. Every country includes components of computer, network and troubleshooting and its level was not much different; however, in United States. Artificial intelligence were covered while in United Kingdom and Korea, this was not included.

Finally, Community, Global and Ethical Impacts (CI) part, three country showed clear difference. In Korea, information literacy was included as a key competency and information and cultural was contained as a key concept, thus, most part of contents on CI part are included in informatics curriculum in Korea. Therefore, in CI part, except for information accuracy, Korean computer science technology curriculum and that of United States were almost identical; however, in United Kingdom, information literacy was not included in key concept so in curriculum, CI were not covered at all. By this comparison, it was possible to say that English computing curriculum had less amount of contents in CI than American and Korean curriculum.

Level 3A

In CL part, although its level changed, the difference amongst countries were same. AS in the level 2, CL is only included in American curriculum, in Korean and English curriculum, Cl was not covered.

Examining CT, the contents of CT in American curriculum are included in ‘algorithms and data’ of English curriculum and ‘problem solving and programming’ and ‘data and information’ of Korean curriculum. In United Kingdom, the contents of connection to other fields, modeling and simulation are not included in curriculum on level 2; however, in level 3A, connection to other fields are covered in data area. Modeling and simulation still were not covered. In Korean curriculum, the contents of connection to other fields are not covered in this level.

About CP part, the contents of programming is covered in every country. Moreover, ‘Using technology tools for the creation of digital artifacts’ and ‘Data collection and Analysis’ had shown similar result; however, in Korean curriculum, encryption, cryptography and authentication techniques were not covered because in 2015 revised curriculum, lots of contents on network were deleted (KICE 2015a). In English computing curriculum, since the entire curriculum was designed focusing on computer science, the contents about career and jobs were not included.

In CD part, the contents of computer hardware and network are covered in every country; however, in United Kingdom and Korea, troubleshooting were not covered in Korean and English curriculum. Human vs Computers which is about artificial intelligence were not covered in both United Kingdom and Korea as level 2. In level 3A, Korean curriculum still not covered this part while English curriculum included Human vs Computers in key stage 3 and advanced level in computers. As the level elevated, the difference of the contents in CD area became more apparent.

Examining final area, CI, Korea and United Kingdom showed clear difference. CI consists of ‘Responsible use’, ‘Impact of technology’, ‘Information accuracy’, ‘Ethics Laws and Security, Equity’ but Korean curriculum did not cover ‘Information accuracy’ and ‘Equity’; however, except for 2 area, informatics curriculum sufficiently covered CI. On the other hand, English curriculum did not cover any content of CI part. Through this comparison, it was possible to say that English curriculum did not reflect enough information literacy.

Level 3B

In CL, the result was the same as level 2 and level 3A. In Korea and United Kingdom, CL part was not covered.

In CT. the result was almost identical with that of level 3A. In United Kingdom, the contents of Problem solving, Algorithms, Data representation, Abstraction were presented in data and program part; however, as before, modeling and simulation were not covered.

In Korean curriculum, abstraction was not covered. Furthermore, some part of Algorithms and Data representation were not contained. Through this comparison, in CT part, Korean curriculum covered less part than American curriculum and English curriculum did.

In CP, the result was the same as that of CT. As the result of level 3A, English curriculum covered all part except for career and jobs. Additionally, the contents were presented in programs, communication and the internet and data. In English computing curriculum, CP contents were not fully covered on level 2A, in 3A and 3B, CP was covered enough; however, about career and jobs, those hod not been covered yet. It is possible to say that this result came out since the English curriculum did not cover information literacy. Korea showed similar level as the American computer science curriculum.

Examining CD part, English and Korean computer science curriculum showed more obvious difference than that on level 3. In English curriculum, except for the contents about network, curriculum covered hardware and artificial intelligence; however, in Korean curriculum, any content was not covered in informatics curriculum. It is possible to presume that many contents of computer science were cut out since the revision in 2015 were conducted focusing on computational thinking, information literacy and collaborative problem solving. Particularly, in high school curriculum, the contents of hardware, operation system and network could be remained, the others were removed. Consequently, it was possible to say that in Korean informatics curriculum, the contents of CD part which included computer hardware, network were not covered by the elevation of its level.

In CI part, Korean and English curriculum showed similar composition. In CI part, ‘Responsible use’, ‘Impact of technology’, ‘Ethics, Laws and Security’ and ‘Equity’ should be included; however, in Korean and English curriculum, only ‘Impact of technology’ part was covered and the other parts were not covered at all. Although Korean curriculum emphasized information literacy, in level 3B, it was rare to find the contents of it.

Through this curriculum comparison, it was possible to review the characteristics of each curriculum. American curriculum, based on 5 strands, presented computational thinking, information literacy, information communication and technology literacy maintaining its balance. Moreover, by the level went up, the contents of much higher level were presented. English computer science curriculum showed clear variation by area. Computer science, Information technology, Digital literacy based on key process, computational thinking, were covered, information literacy was not covered at all. Thus, CT, CD, CP were fully covered in curriculum while CI and CI were not contained. It is difficult to foster talents with all necessary literacy thorough this curriculum. Therefore, it is needed to adjust curriculum to cover contents of diverse competency. Finally, in Korean curriculum, revision of curriculum was conducted based on information and culture, data and information, problem solving and programming, computing system;

however, while making it compulsory course, it was inevitable to develop informatics curriculum for everyone and it was unavoidable to develop curriculum for 34 lesson hours in middle school. Thus, informatics curriculum could not covered much so the level of the contents was not higher than that of the other countries. This Korean curriculum could convey minimum amount of computer science educational contents for every student; however, it was not appropriate to provide computer science knowledge, computational thinking, information literacy, digital literacy for students in modern society. Thus, new computer science curriculum model complementing its insufficient contents should be developed to promote competence of Korean middle and high school students.

Conclusion

This study is the advance research for computer science curriculum model development, international computer science curriculum were analyzed. Computer science curriculum of various countries were collected and those were analyzed by the review of experts. The conclusion of analysis are following:

First, English computing curriculum lacked information literacy. Comparing with the CSTA K-12 Computer Science standards, career and jobs in information ethics, the impact of technology, information accuracy, information ethics and equity were not covered. Korean curriculum contained information and cultural so the contents of information literacy were covered enough.

Second, Korean informatics curriculum had less amount of contents about computer science. Computational thinking and programming were covered enough; however, the contents of computer hardware, network and troubleshooting in Computer and Communications Devices area were insufficient.

Third, Collaboration was not covered neither in Korean curriculum and English curriculum. Since the computer science has bountiful performance through collaboration, CSTA K-12 Computer Science standards are recommending students to have collaborative attitude with computer science learning; nonetheless, in English curriculum, the contents about collaboration were not covered at all. In Korean curriculum, it was not covered either but in key competency, collaborative problem solving was included.

Fourthly, the contents about artificial intelligence was presented in American curriculum only. Owing to the development of computer science technology, studies on deep learning and machine learning are vigorously conducted and artificial intelligence, utilizing this technology, is applied in various industries. Nevertheless, in Korean and English education, the contents about artificial intelligence were removed since it was difficult. However, it is needless to say that computer science curriculum must include artificial intelligence to have necessary competency for modern society.

Based on this research, in Korean curriculum, the contents of collaboration and computer science are insufficient and its level is also lower than the others' curriculum. To complement this, it is needed to develop new computer science curriculum model reflecting Korean education context and the result from analysis of curriculum. Additionally, pre-existing curriculum lacks the connectivity amongst primary, secondary and tertiary education, therefore, it is necessary to establish curriculum model connecting primary, secondary and tertiary education to foster software talents.

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