K-12 Software Education and Future Skills

Hyeoncheol Kim, Ph.D.
hkim64@gmail.com

Korea University, Seoul, Korea
The Korean Association of Computer Education
2017.5
Automation and High Productivity
• 60% of current jobs will be changed.
• Simple routine jobs will disappear.
• Job skills: increasing and higher level.

Solution
• Fast Education system for new, higher and various skills

Digital, SW, AI Revolution
Industries goes to SW/Internet-based services.
• 7 of top 1 companies belong to here
• Most of new jobs coming from here

Big change for job markets
• Size of a company is not proportional to size of hiring.
• Independent, flexible work hours
• More global

One of solutions
• Quick, Small startups.

New Competencies needed
Competences
Critical Thinking, Creativity, Communication, Collaboration

Mindset and Talent
Curiosity, Initiative, Persistence, Empathy, Adaptability

Core Literacies
Reading/Writing, Numeracy, Scientific literacy, ICT fluency, Language skills, Cultural and civic awareness

Domain Knowledge, Job skills
Areas of specialization Expertise

Computational Thinking
• Digital Literacy, Data-based thinking

Creative Thinking
• Problem finding, entrepreneurship

Sharing and Collaboration

Global Standards
New ethics, Public/Social thinking

Adaptability to changes

Changes in Education
• Computational Thinking
• Convergence, Creativity
• Entrepreneurship

K-12 Computing education
• UK curriculum for 5-16 yr-old students. (2014)
• USA : CS for all, STEM
• France, Finland, Japan, China, etc.

K-12 Pedagogies
• New assessment (no multi-choice, Absolute grading) New SAT, AP-CSP, IB
• New subjects in new curriculums
• Smart education system
• Competency rather than knowledge
• Changes in governance

Higher education
• Comp thinking and Coding classes
• Job skills (competency-based vs degree)
• No declaring a major
  : Flexible major

New types of higher skill education (Speed, expertise, adaptability)
• Customized (pace, subject, motivation, place)
• Fast learning technologies
• MOOC, Nano degree
• Competency-based education
  • Job education, life-long education
  • Module-based, micro degree
• Join new job market faster

In Korea
Bad news (K-12)
• ICT literacy Low-ranked in PISA 2012.
• Old-fashioned college entrance exams.
  • 70% of an age group goes to college, especially best college
  • Too much competitions.
• Destroys normal education in schools

Good news
• K-12 SW education (in 2018)
  • SW-specialized high schools
• SW oriented college projects (in 2015)
  • Support computing oriented curriculum
  • Coding education for all majors

Obstacles (K-12)
• No separated subject categories
• Hours and teachers
• Well-prepared teacher training
• College entrance exams

by: Hyeoncheol Kim 2017
“It is general literacy education, not vocational education.”
K-12 Computing Curriculum in Korea
• What to teach:

  • Using educational programming languages and software, learn to express and implement their creative ideas and solutions to improve current world.

  • To increase Computational Thinking

  • To obtain perspectives for future digital world, and adaptability to changes ahead.
[Informatics] Core Competency (beginning in 2018)

1. Digital Culture Literacy
   • Ethical mindset
   • Information security
   • ICT literacy

2. Computational Thinking
   • Abstraction
   • Automation (such as programming)
   • Creativity and integration

3. Collaborative Problem Solving ability
   • Collaborative computational thinking
   • Digital communication skills
   • Sharing and collaboration skills
[Informatics] Objectives for middle school

Cultivating basic levels of cyber ethics and data protection capability and applying the ability to use information technology, computational thinking and collaborative problem-solving skills for their daily lives.
### Informatics Content Subjects (beginning in 2018)

<table>
<thead>
<tr>
<th>영역</th>
<th>핵심개념</th>
<th>내용요소</th>
</tr>
</thead>
<tbody>
<tr>
<td>정보문화</td>
<td>정보사회</td>
<td>정보기술의 특성과 진로</td>
</tr>
<tr>
<td></td>
<td>정보윤리</td>
<td>개인정보와 자작권 보호, 사이버 윤리</td>
</tr>
<tr>
<td>자료와 정보</td>
<td>표현</td>
<td>자료의 유형과 디자인 표현</td>
</tr>
<tr>
<td></td>
<td>분석</td>
<td>자료의 수집과 정보의 구조화</td>
</tr>
<tr>
<td>문제해결과 프로그래밍</td>
<td>추상화</td>
<td>문제 이해, 핵심요소 추출</td>
</tr>
<tr>
<td></td>
<td>알고리즘</td>
<td>알고리즘 이해, 알고리즘 표현</td>
</tr>
<tr>
<td></td>
<td>프로그래밍</td>
<td>인력과 환경, 변수의 연산, 제어 구조, 프로그래밍 응용</td>
</tr>
<tr>
<td>컴퓨팅 시스템</td>
<td>통합원리</td>
<td>컴퓨팅 기기의 구성과 동작 원리</td>
</tr>
<tr>
<td></td>
<td>피지컬 컴퓨팅</td>
<td>센서 기반 프로그램 구현</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Domain</th>
<th>Key Concept</th>
<th>Middle school</th>
<th>High school</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information and Culture</td>
<td>Information Society</td>
<td>• Properties and careers</td>
<td>• Computer Science and Society</td>
</tr>
<tr>
<td></td>
<td>Information Ethics</td>
<td>• Personal Info, copyrights, cyber ethics</td>
<td>• Info security, copyrights, cyber ethics</td>
</tr>
<tr>
<td>Data and Information</td>
<td>Data Representation</td>
<td>• Data types and Digital representation</td>
<td>• Efficient digital representation</td>
</tr>
<tr>
<td></td>
<td>Data Analysis</td>
<td>• Data collection and management, Information structure</td>
<td>• Data analysis, Information Management</td>
</tr>
<tr>
<td>Problem solving and Programming</td>
<td>Abstraction</td>
<td>• Problem understanding, Extracting key elements</td>
<td>• Problem analysis, Decomposition and modeling</td>
</tr>
<tr>
<td></td>
<td>Algorithm</td>
<td>• Understanding, Expression</td>
<td>• Design, Analysis</td>
</tr>
<tr>
<td></td>
<td>Programming</td>
<td>• Variables, operation, Input and output, Control structure, Application</td>
<td>• IDE, Variables and types, Operators, Std. I/O and file I/O, Array, Function, Application</td>
</tr>
<tr>
<td>Computing System</td>
<td>Components</td>
<td>• Components and its roles</td>
<td>• Operational system</td>
</tr>
<tr>
<td></td>
<td>Physical Computing</td>
<td>• Programming with sensor data</td>
<td>• Network, Physical computing practices</td>
</tr>
</tbody>
</table>
Educational Programming Languages
(Easy and Fun)
SW leader School Program

<table>
<thead>
<tr>
<th>Year</th>
<th># of leader schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>160</td>
</tr>
<tr>
<td>2016</td>
<td>900</td>
</tr>
<tr>
<td>2017</td>
<td>2,000</td>
</tr>
</tbody>
</table>

- 5,934 elementary schools
- 3,186 middle school
- High schools
  - 1,520 general high
  - 143 specialized
  - 164 charter school
  - 499 vocational high
SW-oriented University Project
2015 - 2020

• Computing camp for newbies
• Computing curriculum for non-majors
• Combined Curriculums
• Community services (Camps for K-12)
• Industry-oriented curriculums (ex. Internship)
• Special Admission to SW talented students
Wishes

• Use ‘SW computing education’ as a leverage to change today’s education into new paradigm

  • Sharing and Collaboration, rather than competition and comparison
  • Problem finding, in addition to problem solving.
  • Digital literacy, Creativity,
  • Public and social minded, Global minded
  • Job skills in Digital creative economy