Understand the latest Science and Technology issues with SW education!

# SW Education Module Textbook

"Developing computational thinking through SW-based multidisciplinary education"

SW education helps students learn to handle problems through computational thinking. Students can learn how to identify and solve various problems through SW education. Different disciplines, such as mathematics, science, technology, engineering, and arts, may converge effectively in SW education. By employing these textbooks, students will find themselves interested in SW education and will understand that SW is involved in all areas, realizing the principles of how computers work and feeling a sense of accomplishment to solve problems on their own.

Criteria of Selecting Textbook Topics

## 10 Major Technologies of the Future

Several organizations, including Information Handling Services (IHS), Gartner, the Ministry of Science and ICT, Seoul National University, and KAIST, have recently announced the major technologies of the future. Among those suggested, ten topics were selected as having the most referrals and relevance to school curriculums.


Let's take a look at artificial intelligence (AI), which has become so familiar to us in the presence of examples like Alpha Go. AI was not really so intelligent in the past, but its development has reached a tremendous pace over time. How has AI become as smart as human beings? It is said that AI will come to replace humans in their jobs in the future. Will that really be the case?

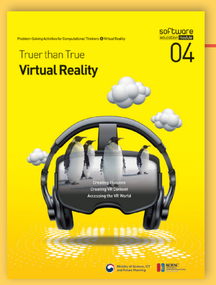
PART 1 Deep Learning, Learning through Repeating
PART 2 Monte Carlo Tree Search
PART 3 Living in an Artificial Intelligence World


The boundaries between industrial sectors are now disappearing. IT leaders like Google and Apple have recently entered the automotive industry. With this development, the dream of driverless vehicles is rapidly becoming a reality. Imagine the changes in the future in transport.

PART 1 Era of Driverless Vehicles
PART 2 Find the Shortest Route!
PART 3 Make Your Own Driverless Vehicle


Until now, humans have analyzed the surrounding environment to give commands to a computer on what to do, but there will be no need to do this in the future. In the future, devices and objects will exchange information with each other and make judgments for themselves. What will the world of IoT look like and what needs to be supplemented?

PART 1 Internet of Things (IoT)
PART 2 IoT and Security
PART 3 Diverse IoT Services




Television remains the most influential type of media at present, but VR will soon take over the lead. The virtual world makes it possible to meet friends who live far away and creates the sense that you are physically in the same space. It also allows you to travel to the other side of the world without leaving the comfort of your own room. In the future, we may not even be able to distinguish between the virtual world and the real world.

PART 1 VR Creating Illusions
PART 2 Creating VR Content
PART 3 Accessing the VR World


The development of molecular biology enabled us to deal with genes, but cutting genes with complete precision was not possible until the emergence of CRISPR technology. CRISPR is like a pair of scissors that can cut genes without making any errors. What makes scientists so enthusiastic about CRISPR that they have recognized it as a strong candidate for the Nobel Prize?

PART 1 Genetic Materials: An Overview
PART 2 DNA Coding & Gene Recombination
PART 3 CRISPR: Genetic Scissors


Space launching vehicle (SLV) technology is the result of technological integration from diverse sectors and is considered as one of the standards for measuring a country's level of national power. Let's take a look at the principles behind an SLV and the technologies required to precisely launch one at a target.

PART 1 Basic Principles of a Space Launch Vehicle
PART 2 The Design of a Space Launch Vehicle
PART 3 Present Location of an SLV?


Natural disasters, such as abnormal weather, earthquakes, and volcanoes, are constantly unfolding all over the world. Though we remain relatively helpless against the powers of nature, sensors and IT technology's analysis of big data now make it possible to predict natural disasters before they actually occur.

PART 1 The Earth is Shaking! Earthquakes
PART 2 Vulnerability Prediction and Disaster Readiness
PART 3 Disaster Management Software


Medical technology is rapidly developing in conjunction with computer science. Artificial organs made by 3D printers will soon be implanted into our bodies, while a computer will be able to diagnose our ailments accurately by analyzing medical big data. It's time to welcome the era of smarter medicine!

PART 1 Cyborg Now a Reality
PART 2 Smart Diagnosis and Telemedicine
PART 3 Bioinformatics Extend Lifespan


With the advancement of computer technology, games are rapidly developing, and the computer game market is also continuously growing. Game engines serve as one of the secrets to making games quickly and easily. Understand the basic principles behind computer games and learn to design your own game.

PART 1 Traditional Games Revisited
PART 2 How Game Characters Move
PART 3 Becoming a Game Developer


The era of sports relying on the intuition of players and coaches has ended. Now, all of the necessary analyses and determinations are made based on training and a multitude of data collected during the games themselves. Let's take a look at the analytical techniques used in sports like baseball and soccer.

PART 1 Selecting Archers for the Olympics
PART 2 Statistics for a Winning Shot
PART 3 Big Data and Soccer

## What is Computational Thinking?

Computational Thinking

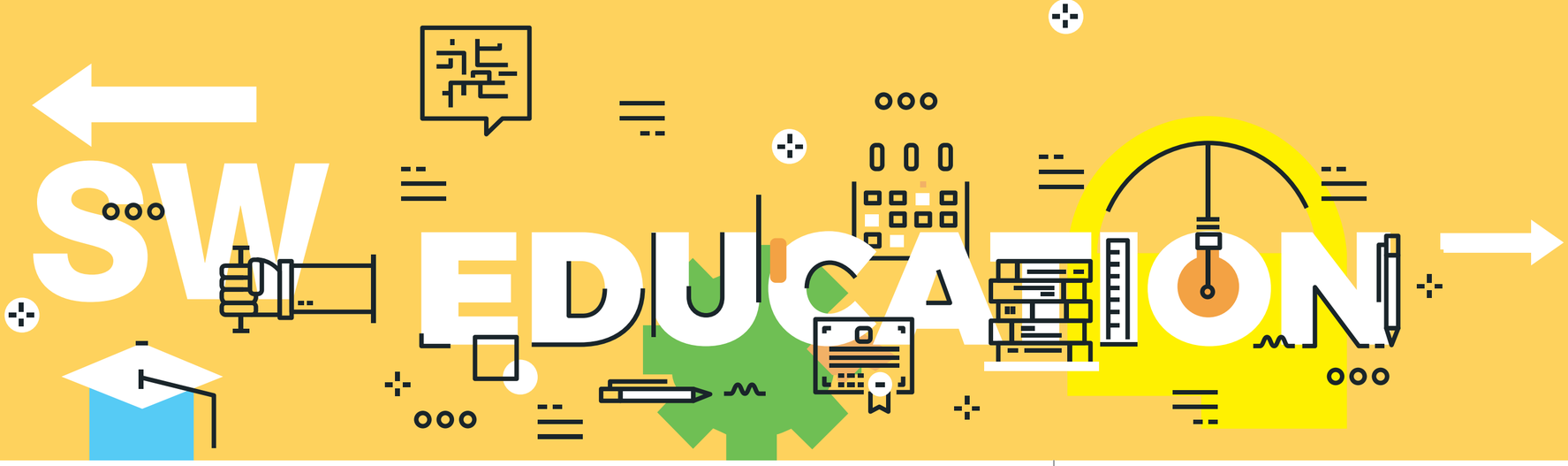
**Problem Decomposition**
Understanding the initial state of the problem and the target state; then, disassembling and analyzing the work to be done to reach the target state

**Recognizing Patterns**
Finding the elements needed for problem-solving and recognizing common parts that form a pattern

**Abstraction**
Defining and modeling the execution flow and data based on key elements and tasks for problem-solving

**Making an Algorithm**
Designing and expressing the problem-solving process to be performed in a computer using a control structure

**Automation**
Automating algorithms by implementing them in programming languages




Ministry of Science and ICT
KOFAC
Korea Foundation for the Advancement of Science & Creativity
한국과학창의재단

SW Education
Module Textbooks

# How to Use

Each textbook consists of small modules. The target grades and relevant subjects are specified for each module. This textbook can be included as part of the school curriculum. It can also be used for creative experience activities at elementary schools or for free semesters in secondary schools.


**Articles**
The latest issues are introduced in the form of an interesting article. Have students read related articles before attending class.


**Education Modules**
Each textbook is organized in modules. You can use the whole textbook in class or select only specific modules of interest.


**Career Exploration & Maker Activities**
These sections introduce career opportunities and maker activities related to the topics in each textbook. These can be used during free semesters in secondary schools.

## Creative Experience Activities for Elementary School Students

| PL= Physical learning
| TB= Textbook
| A = Activity

ICT

- Artificial Intelligence (AI)
- Driverless Vehicles (DLVs)
- Internet of Things (IoT)
- Virtual Reality (VR)

Science

- CRISPR
- Space Launch Vehicles (SLVs)
- Natural Disasters (NDs)
- Smart Medicine (SM)

Mathematics

- Game Engines (GEs)
- Sports Statistics (SS)

| | | | | |
|---|---|---|---|---|
| AI | How does a computer distinguish dog and cat | Unplugged | TB A | B |
| AI | Robot cleaner programming | EPL; Entry | TB A | CB |
| AI | Making a robot write articles | Unplugged | TB A | CI |
| DLVs | Be a pathfinder | Unplugged | TB A | B |
| DLVs | Help Hanbi find the shortest route | Unplugged | TB A | B |
| DLVs | Turn hamster robot into an SDV | PL; Hamster | TB A | CI |
| IoT | Make your home smart, Create a smart home | EPL; Scratch | TB A | CB |
| IoT | Making smart bulbs | EPL; App Inventor | TB A | CB |
| VR | VR and sensor values | PL; Smart devices | TB A | EC |
| SLVs | Programming a multi-stage rocket | EPL; Entry | TB A | CB |
| NDs | Measuring a virtual earthquake with a vibration measurement app | PL; Smart devices | TB A | EC |
| NDs | Prevent a disaster in your neighborhood! | Computer based class | TB A | B |
| NDs | Create an app to send out disaster a warning message | EPL; App Inventor | TB A | CA |
| GEs | Building a board game based on Yut Nori | EPL; Scratch | TB A | B |
| SS | Making a soccer heat map | Unplugged | TB A | CB |

## Secondary School Curriculum

| | | | | |
|---|---|---|---|---|
| AI | Learning Monte Carlo tree search with Tic-Tac-Toe | Unplugged | TB A | B |
| VR | Experiencing VR | PL; VR devices | TB A | EC |
| VR | Stitching photos together | Unplugged | TB A | B |
| SLVs | Launching $CO_2$ rockets | Unplugged | TB A | EC |
| NDs | Frequent earthquake locations | Computer based class | TB A | B |
| SM | How a 3D printer works for artificial organ printing | Unplugged | TB A | EC |
| SS | Calculating the variance of an archery score | PL; Smart devices | TB A | EC |
| SS | Making a sabermetrics calculator | EPL; Scratch | TB A | CI |

## Free Semesters of Secondary School

| | | | | |
|---|---|---|---|---|
| IoT | Collecting friends' birthday information with RSA | Unplugged | TB A | CA |
| CRISPR | Functions of the bases in RNA | Unplugged | TB A | BT |
| CRISPR | Find a specific nucleotide sequence! | Computer based class | TB A | BT |
| CRISPR | Make your own CRISPR game | EPL; Scratch | TB A | CI |
| SLVs | Conducting a mission with the GPS | PL; Smart devices | TB A | EC |
| SM | Understand a medical treatment flowchart | Unplugged | TB A | CI |
| SM | Find a DNA | EPL; Scratch | TB A | CI |
| GEs | Aircraft collision detection | Unplugged | TB A | BT |
| GEs | Making a state diagram | Unplugged | TB A | BT |
| GEs | Building a game by using a Game Engine | EPL; GameSalad | TB A | CA |
| GEs | Making Flappy Bird by using GameSalad | EPL; GameSalad | TB A | CA |

### Beginner (B)
In elementary school classes where SW education is first implemented, cultivate students' computational thinking based on unplugged activities and increase their interest with Computer based lessons.

### Experience-Centered (EC)
Before starting full-fledged SW education, lead students to raise their interest using a variety of devices. Students are likely to concentrate on such lessons, as they can handle the IT equipment in person.

### Coding Beginner (CB)
For students who are new to EPL, try Entry or Scratch programs with fewer blocks and less difficulty.

### Coding Intermediate (CI)
For students who are somewhat familiar with EPL, try Entry or Scratch programs using variables, operations, and so on. These students may also enjoy the challenge of physical learning with a hamster.

### Coding Advanced (CA)
If both teachers and students are experienced in EPL and want to take on more challenges, try out new tools, such as App Inventor and GameSalad, which may still be unfamiliar.

### By Topic (BT)
Because of the overall relevance, CRISPR and game engines are good at handling topics from start to finish. This is a time-consuming process, so try it out during creative experience sessions or a free semester.

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