Here, There, Everywhere
Creativity Based Network University

충북대 융합교육프로그램개발사업단

AI로 STEAM을 그리다

일시 | 2023. **8**. **18**.(금) 16:00~20:00

장소 | 광주교육대학교 교육매체관 오헌실

• 주최 : 광주교육대학교교육대학원 충북대창의교육거점센터 • 주관 : 충북대 융합교육프로그램개발사업단 대한지구과학교육학회 아꿈선

• 후원 : 교육부 한국과학창의재단

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일정표

8월 18일 금요일

시간	내용	발표자(담당자)
16:00–18:00	The Meaning of Learning in the Fourth Industrial Revolution	박도영 (교수, 일리노이주립대)
18:00–19:00	Nature Experience Program using VR	김흥태 (교수, 서원대학교)
19:00–19:30	Teachers gather to dream of a world without science and educational inequality	한도윤 (교사, 아꿈선)
19:30–20:00	Development and Application of a Case-Bsed Reasoning Instructional Model using Expert System of Artificial Intelligence for STEAM	김형범 (교수, 충북대학교)

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CONTENTS

특별 강연

The Meaning of Learning in the Fourth Industrial Revolution (4차 산업혁명시대의 학습의 의미)

Park , Do-Yong (박도영), Ph.D.
Fulbright U.S. Scholar
Professor of Science Education
Illinois State University | USA
GNUE, Gwangju, Korea
8/18/2023

Talking Points

1, 4th Industrial Revolution
2, Digital Transformative Classroom
3, STEM Education

“Keen Insight”

La Clairvoyance, 1936 by Rene Magritte

What does it mean to learn in the 4th Industrial Revolution?

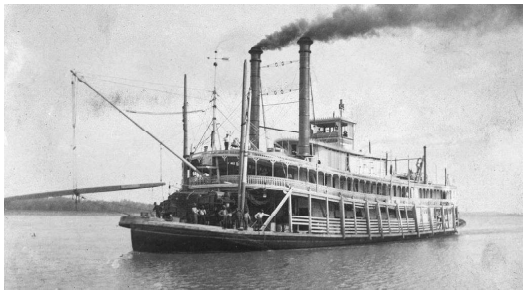
What philosophy do you have regarding the use of artificial intelligence (AI) in the classroom?

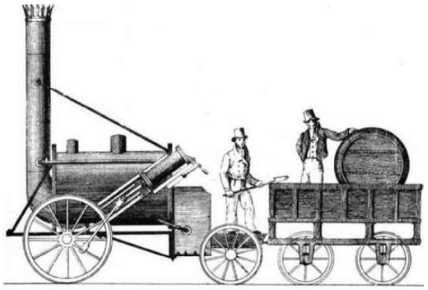
Talking Point 1

4th Industrial Revolution

-Industry 4.0 (Germany, China)-

1st Industrial Revolution (Industry 1.0) (18-19C): Steam Power





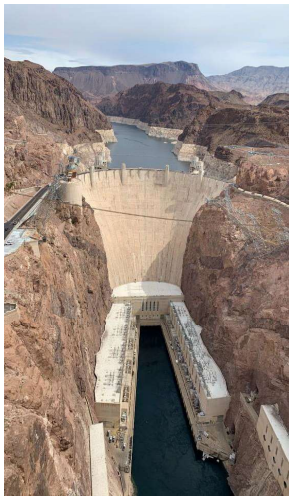
Why did 1st industrial revolution occur in UK?

- Two Reasons:

--Skills and Ability to **Record and Accumulate** Knowledge

--**Culture** of Respecting Scientists and Engineers

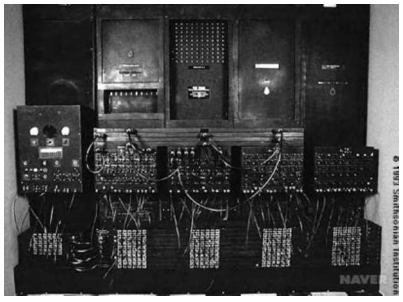
2nd Industrial Revolution (Industry 2.0)
(19-20 C): Electricity

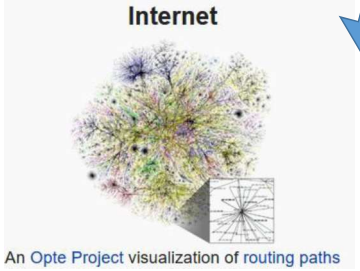


Electricity

Internal combustion engine

3rd Industrial Revolution (Industry 3.0)
(1970 – 21C): Information Technology

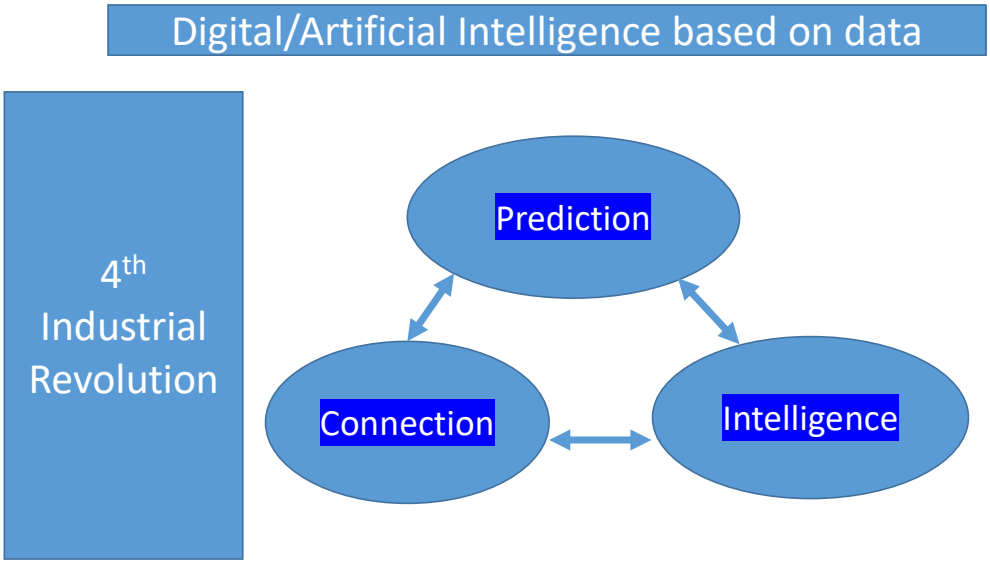




An Opte Project visualization of routing paths

IT

4th Industrial Revolution: Industry 4.0



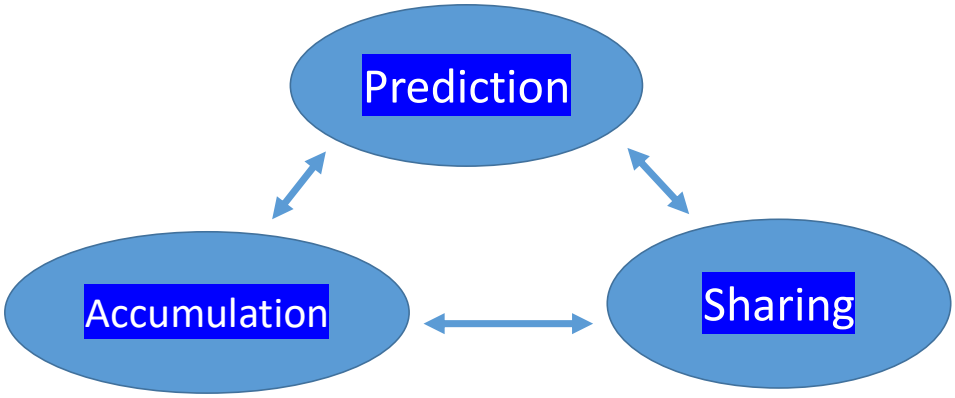
Characteristics of 4th Industrial Revolution

-- 4th Industrial Revolution replaces human labor.

-- 4th Industrial Revolution replaces human brain.

Characteristics of 4th Industrial Revolution

- Digital Intelligence will revolutionize the world more than humans.



Education in Each Industrial Revolution

- **First Industrial Revolution** – Steam Power: Small Production
--Focus: Individual + Individual Education

- **Second Industrial Revolution** – Electric Power: Mass Production
--Focus: Nuclear Family, Company + Public Education (Factory Workers)

- **Third Industrial Revolution** - Informational Technology
--Focus: Internet, Renewable Energy + Discipline-centered Education

- **FOURTH Industrial Revolution(21C)**? Intelligent Education

SUM: 4TH Industrial Revolution

- Definition: Intelligence Revolution based on accumulated data to problem solve
- 3 Keywords: Prediction, Intelligence, & Connection
- FOURTH Industrial Revolution Tech

- AI, AR, VR, Internet of Things (IoT), Ubiquitous tech, Cloud Computing, Big Data, Mobile, Supercomputing, Graphene (Nano Tech), Artificial Intelligent Robots, Self-driving Cars, Neuro-Technological Brain Enhancements, Genetic-editing.

- Change: Dramatic change in speed, scale, scope, complexity, knowledge.
- Speed: Happening at the exponential speed.

- 2 Keywords to make a better decision: Decentralization & Integration

What does it mean to learn in the era of Digital Intelligence of the 4th Industrial Revolution!

Intelligence based on accumulated data to problem solve

Prediction, Intelligence, & Connection

Decentralization & Integration

Teaching and Learning Focus:
Problem-solving rather than knowledge

Talking Point 2

Digital Transformative Classrooms in the 4th Industrial Revolution

Digital Transformative Classrooms in the 4th Industrial Revolution

- **What is Digital Transformation** (Marcum, 2014):

- Combines digital technologies and services
  - Creates collaborative, interactive and personalized learning experiences

- Marcum, D .(2014). The Digital Transformation of Information, Education, and Scholarship. International Journal of Humanities and Arts Computing, 8(1) , 1–11.

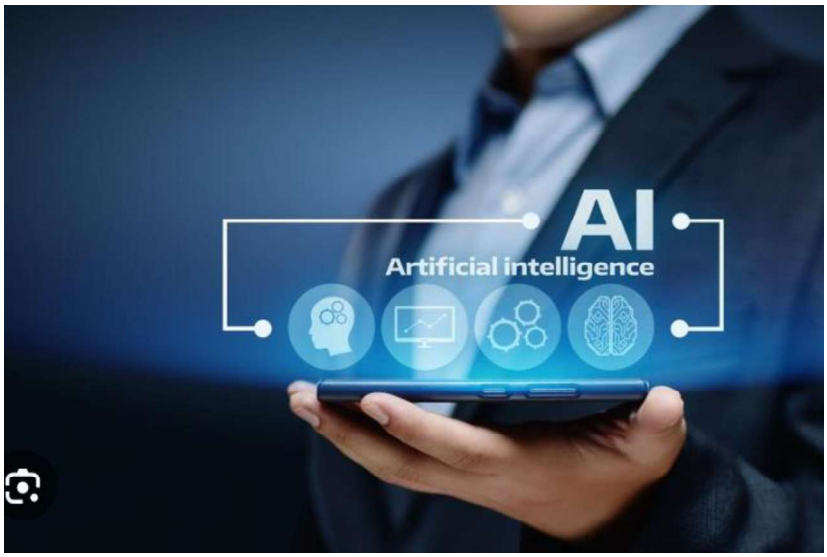
Future Teaching and Learning Modalities in digital transformation classrooms

1, Virtual Reality (VR) and Augmented Reality (AR) technology:
2, Artificial Intelligence (AI) integration:
3, Internet of Things (IoT):
4, Collaborative learning spaces:
5, 3D printing and prototyping:
6, Online and hybrid learning:
7, Cloud-based learning:
8, Emphasis on soft skills:

Virtual Reality (VR) and Augmented Reality (AR) technology

- Students experience simulations of real-life situations using VR and AR technology.
- Students learn in a more engaging and immersive way.
- Online communities, blog, company facilitation, etc

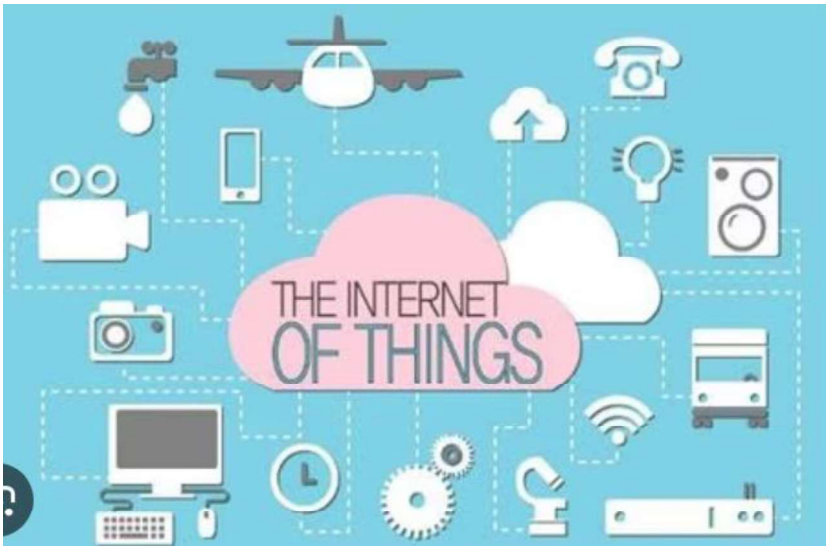
Artificial Intelligence (AI) integration:



- AI tools will provide personalized learning experiences for students, including recommendations and feedback.
- Make lesson plans, Text to Speech, Images to Animate

- **CoPilot:** Generate Lesson Plans & Other Educational Materials in Seconds https://www.youtube.com/watch?v=9HAUYuzYxqw&t=308s
- **Curipod:** Make interactive lessons filled with creativity, reflection and critical thinking
- **ChatGPT:** Lesson Plans & Grading student essays - based on Input: question, answer, rubric, points.
- **Murf AI**: Text to Speech
- **CANVA:** Text to Images

Internet of Things (IoT):



- IoT sensors will monitor classroom environments, including temperature, air quality, and lighting, to optimize learning conditions.
- Incorporation into lessons

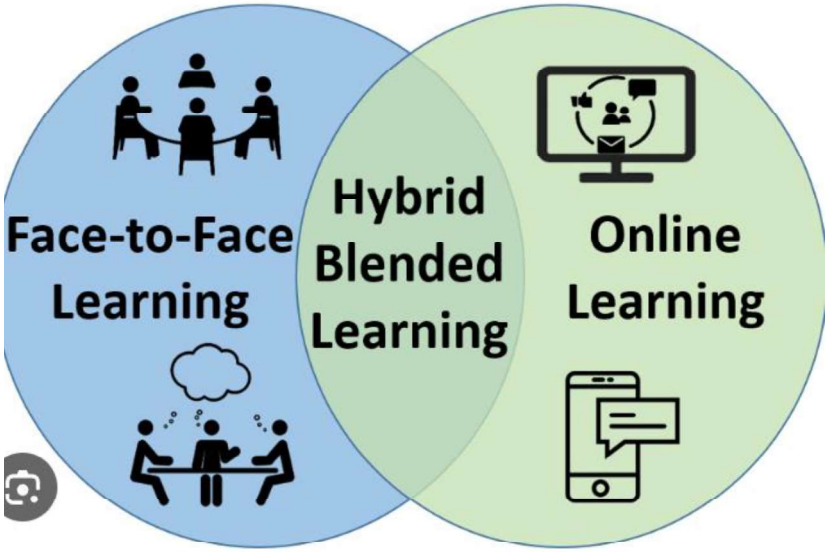
Collaborative learning spaces:

- Classrooms will be designed to facilitate group work and collaborative learning, with flexible seating arrangements and technology-enabled project spaces.

3D printing and prototyping:

- Students will have access to 3D printers and other prototyping tools to help them bring their ideas to life.
- Thingiverse (https://www.thingiverse.com) , Digital Design tools

Online and hybrid learning:



- Blended learning models that combine online and in-person instruction will become more common, providing students with more flexibility and access to learning

Cloud-based learning:

- Cloud-based learning management systems will become more prevalent, enabling students and teachers to access learning materials from anywhere and on any device.

Emphasis on soft skills:

- AI tech becomes common, there will be a greater emphasis on teaching soft skills such as communication, collaboration, and problem-solving to prepare students for the changing nature of work.

eLearning Tools

- **Kahoot** – formative assessment tool for quizzes and games
- **Quizizz / Quizlet / Google Quizzes :** whole class activity to solve quizzes
- **Nearpod** – Teaching Software
- **Google Classrooms** - LMS (Most popular)
- **Class Dojo** – Class Communities (Students, Teachers, Parents)
- **Kialo Edu**--Teaching critical thinking
- **Flipgrid** –Video sharing app - good for those with writing difficulty
- Various smartphone platform – SNS, Interactive tools, video editing

Talking Point 3

STEM Education
(Teaching and Learning)

South Korea vs. Singapore
GDP per capita

South Korea
1970 - $270

Singapore
1970 - $920

South Korea vs. Singapore

GDP per capita

South Korea

2020 - $33,423

Singapore

2020 - $65,641

GDP per capita

(GDP: Gross Domestic Product)

South Korea

1970 - $279

2020 - $33,000

>118 times

Singapore

1970 - $926

2020 - $65,000

>70 times

WHAT MADE A DIFFERENCE?

STEM Education
-Engineering, Technology-

WHY STEM?

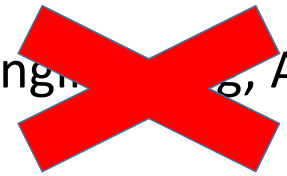
4th Industrial Revolution
-Industry 4.0 (Germany, China)-

WHAT IS STEM Education?

- Science, Technology, Engineering, and Mathematics(STEM)

  Definition:
  Using more than two fields of STEM, we solve human problems in a creative and integrated way.

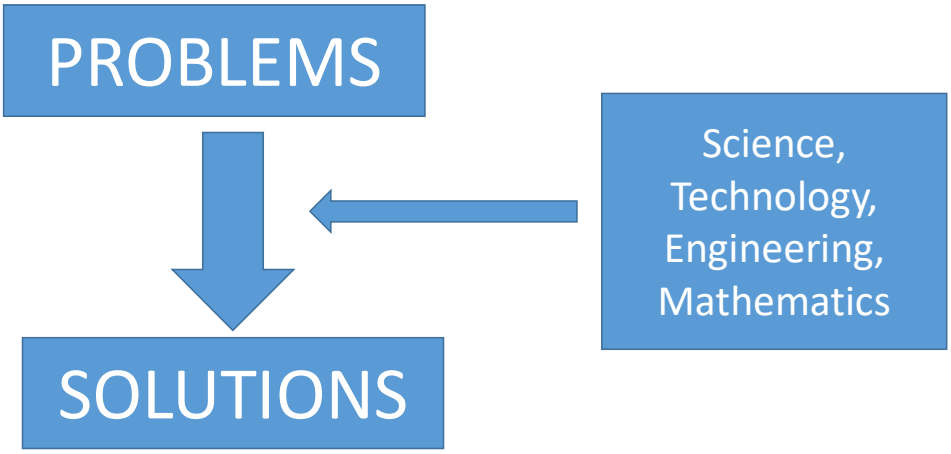
- Science, Technology, Engi[redacted]g, Arts, and Mathematics(STEAM)



Confusion about STEM Education …

- Is it a curriculum? NO Is it an approach? YES
- Should I use all four S, T, E, M? NO
- Or is it still STEM education even if I use Science and Engineering? YES
- Why problem-based? Because STEM Ed begins with problems.
- Why technology and Engineering are so much emphasized? Because STEM Ed is all about problem solving.
- How should I teach STEM education in my class? Use Inquiry

STEM Education



WHY STEM Education?

- Goal 1: Global Competitiveness
- Goal 2: STEM Workforce

WHY I-Tok Tok? 왜 아이톡톡인가?

STEM Education …

- Is not a **curriculum**. Is an **approach**.

STEM Education …

- Produces a tangible **product** as a solution to solve problems.
- Generates **MONEY** for the country.

STEM Teaching and Learning …

- Begins with **human problems**.
- Uses **more than two fields of STEM** to solve problems.

STEM Teaching and Learning …

- Applies **STEM knowledge and skills** to solve problems.

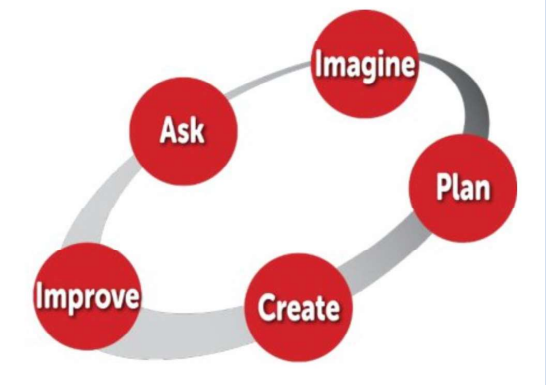
Six Imminent Problems Worldwide (UN)

Population
Food
Energy
Transportation
Climate Change
Water

STEM Education …

- Emphasizes **Technology and Engineering** because of problem solving.

STEM Teaching Model

STEM Teaching Model - NGSS	STEM Teaching - EiE Model
Ask Questions. **Develop and Use Models.** **Plan and Carry out Investigations.** **Analyze and Interpret Data.** **Use Mathematics and Computational Thinking.** **Construct Explanations.** **Engage in Argument from Evidence - including dialogue.** **Obtain, Evaluate, and Communicate Information.**	

Are you ready to answer the following?

- What philosophy do you have regarding the use of artificial intelligence (AI) in the classroom?
- What does it mean to learn in the 4th Industrial Revolution?

Educational Philosophy

- **Perennialism**（항존주의）- Realism
  Focus: Educate the rationale person / classical subjects, great books
- **Essentialism**（본질주의）– Idealism
  Focus: Promote intellectual growth / essential skills, back to basics
- **Progressivism**（진보주의）– Pragmatism
  Focus: Promote democratic, social living / guide to problem solving, humanistic education, free schooling
- **Reconstructivism**（재건주의）– Pragmatism
  Focus: Improve and reconstruct society / equality of education, cultural pluralism, international ed.

Can you see your future education now?

La Clairvoyance, 1936 by Rene Magritte

Thank you!

Questions?

Email me at

doyongpark@gmail.com

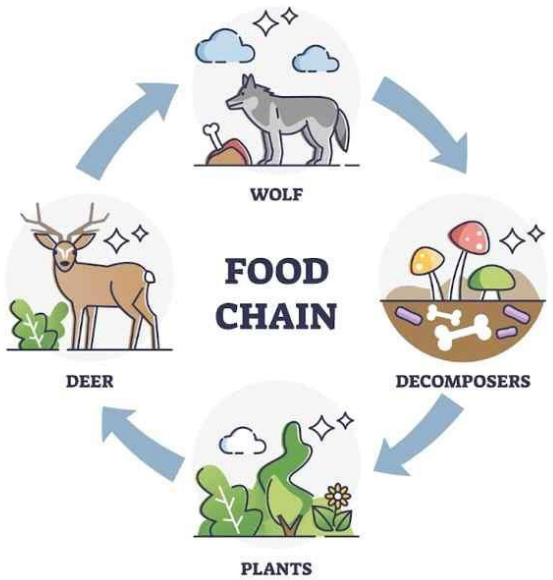
dpark@ilstu.edu

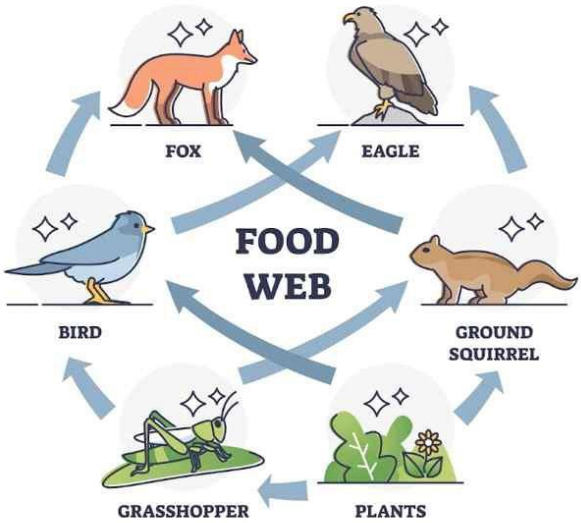
Nature experience program using VR

Heung-Tae Kim

Seowon University

Elements for survival





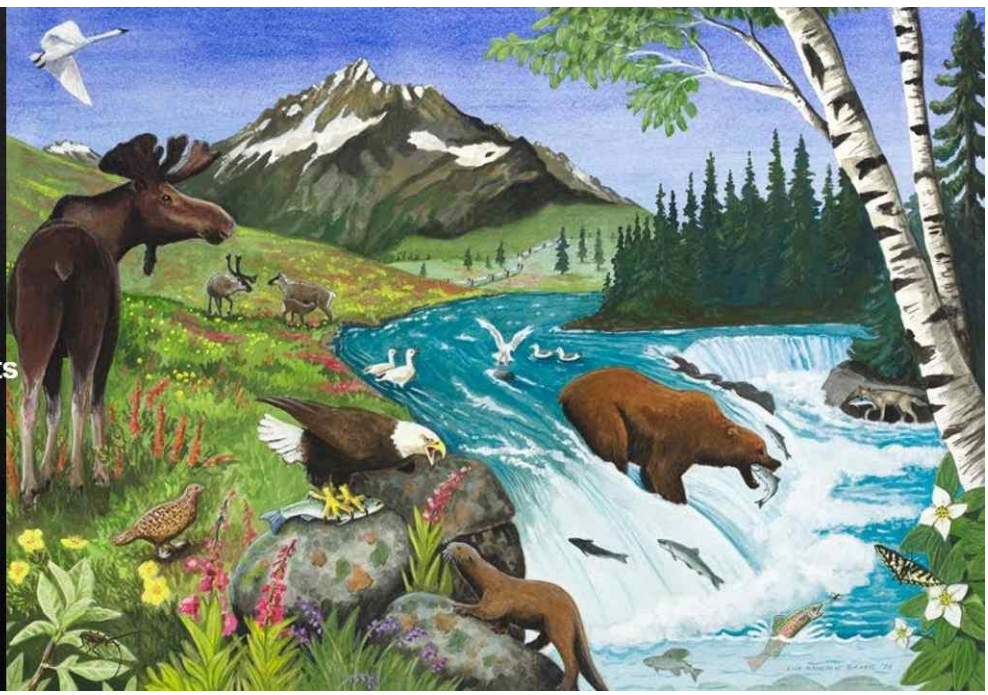
Ecosystem

=

Abiotic elements

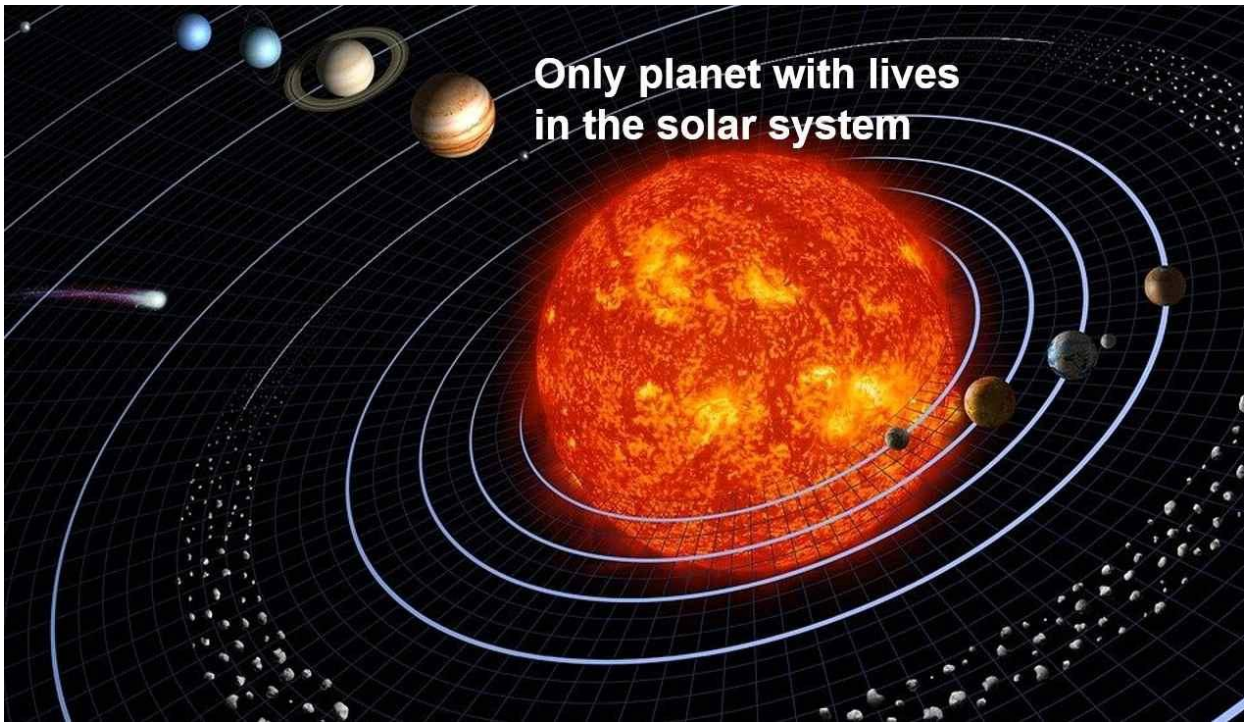
+

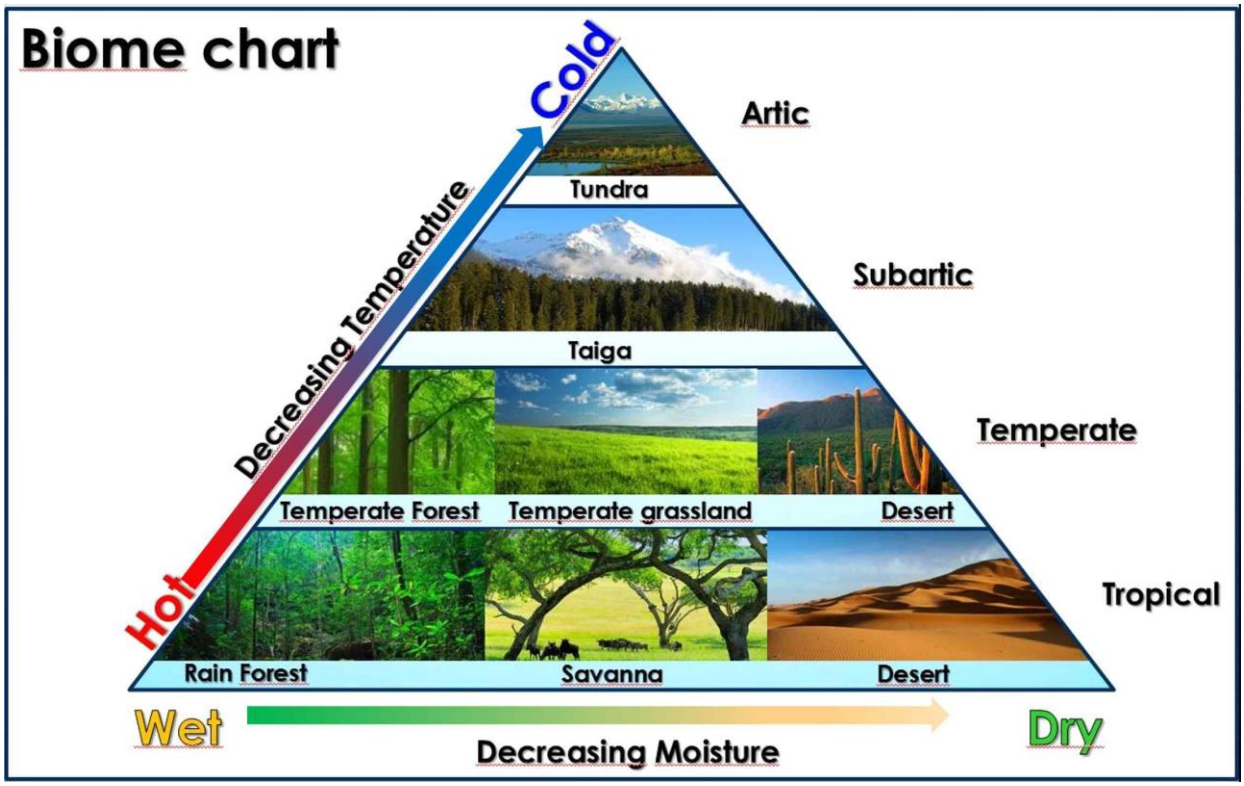
Biotic elements




Types of ecosystem
Pond ecosystem
Urban ecosystem
Soil ecosystem


Beautiful Blue Planet
Precious Earth


Only planet with lives
in the solar system


Biome chart
Cold
Hot
Decreasing Temperature
Artic
Tundra
Subartic
Taiga
Temperate
Temperate Forest
Temperate grassland
Desert
Tropical
Rain Forest
Savanna
Desert
Wet
Dry
Decreasing Moisture


Tropical Rainforest
Temperate Forest
Major Biomes
Boreal Forest
Desert
Savanna
Grassland
Marine
Freshwater
Tundra


Rough northern tundra


Forest:
Boreal forests that endure the cold with needle leaves


Forest:
Temperate deciduous forest
Colorful broad-leaved forest


Temperate grassland with
nutrient-rich soil


Savanna in Africa: seasonal rainfall

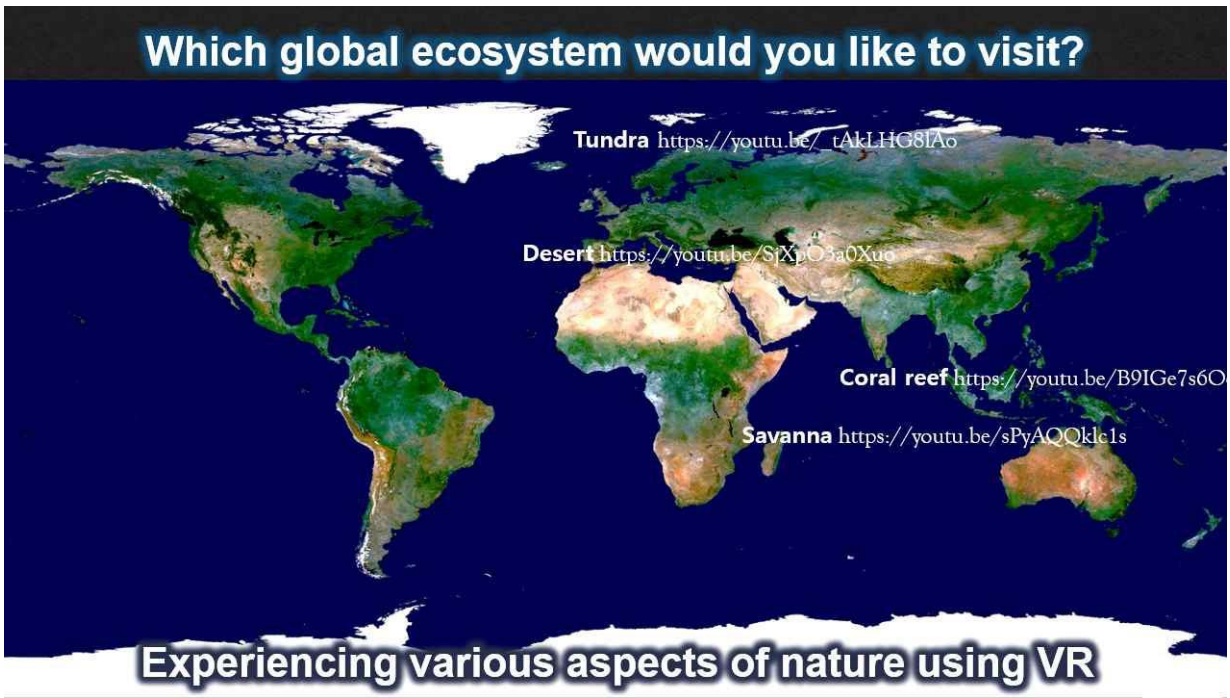

Tropical rainforest with jungle
thick with various plants


Desert:
Hot sand arable land?


Ocean:
Desert of water


Coral reef:
Nest of countless creatures
in the warm shallow sea


Stream ecosystem:
World of flowing water that
connects the land and the sea


Which global ecosystem would you like to visit?
Tundra https://youtu.be/_tAkLHG8lAo
Desert https://youtu.be/SjXpO3a0Xuo
Coral reef https://youtu.be/B9IGe7s6O
Savanna https://youtu.be/sPyAQQklc1s
Experiencing various aspects of nature using VR

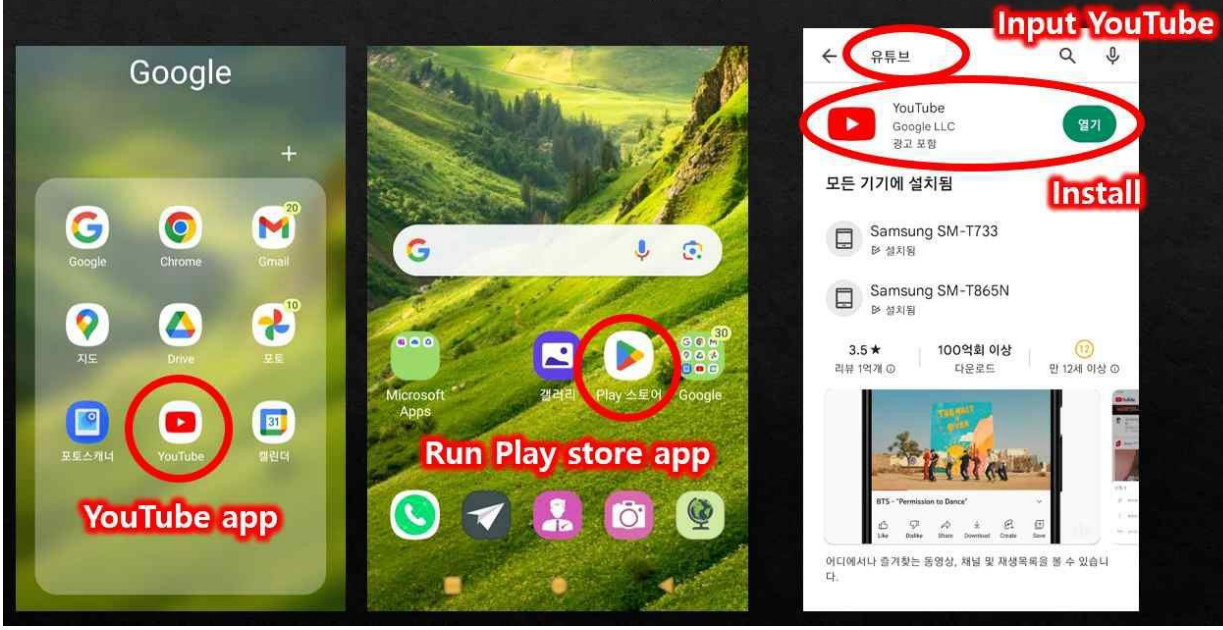

Aurora experience in the polar regions
with VR
극지방 툰드라


Milky way in the desert experience
with VR
사하라 사막

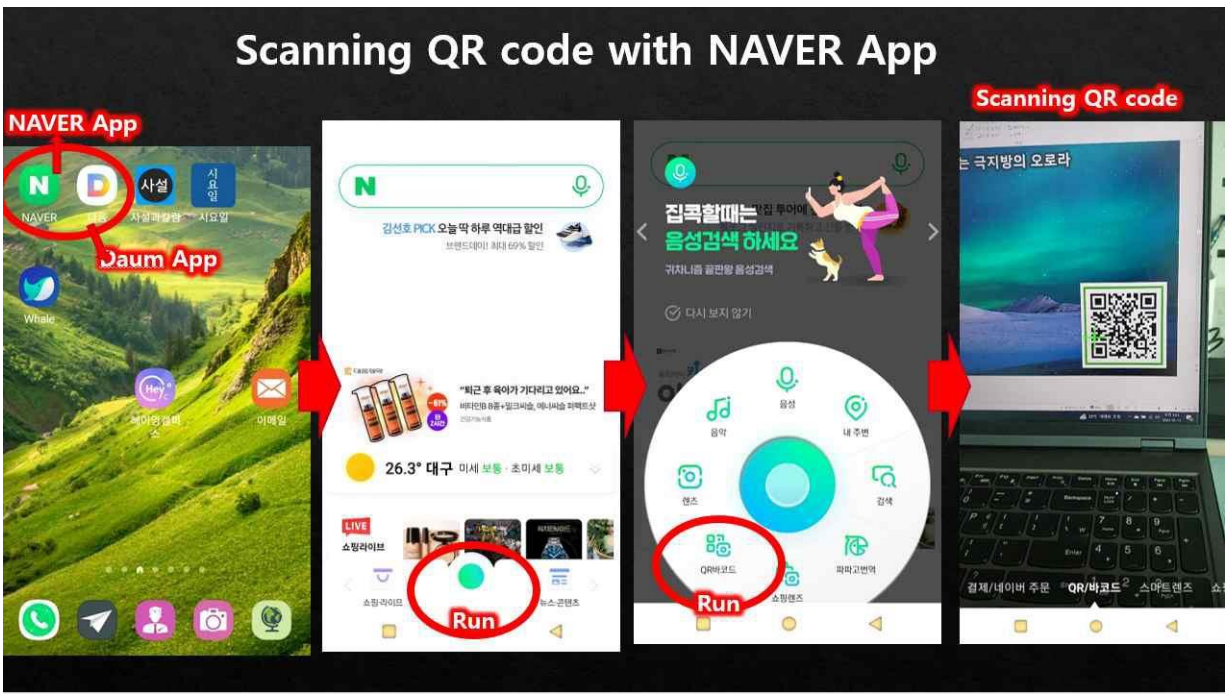

African savanna experience with VR
아프리카 사바나


Underwater coral reef experience with VR
산호초

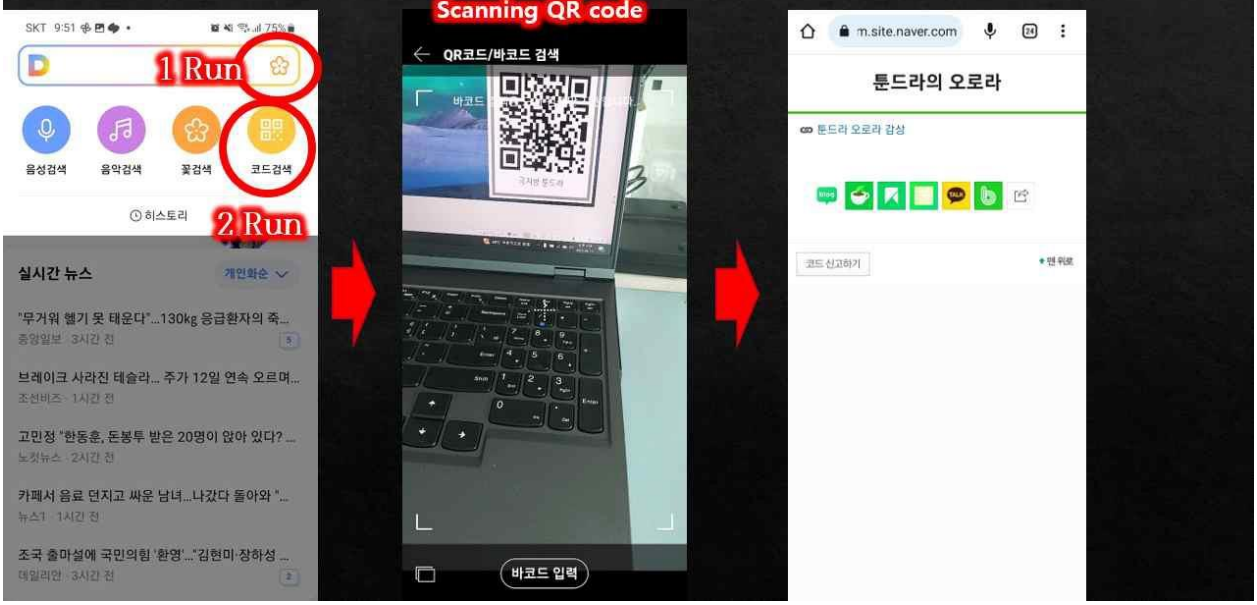
How to install YouTube app to play 360-degree VR video



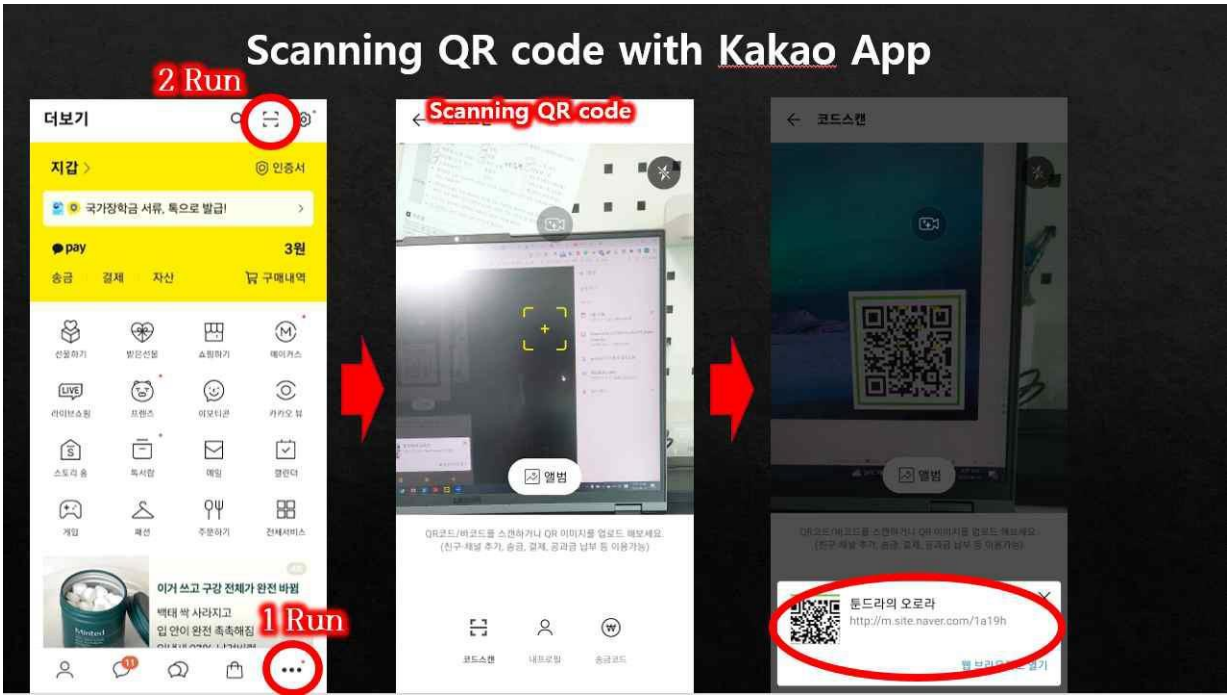
Scanning QR code with NAVER App



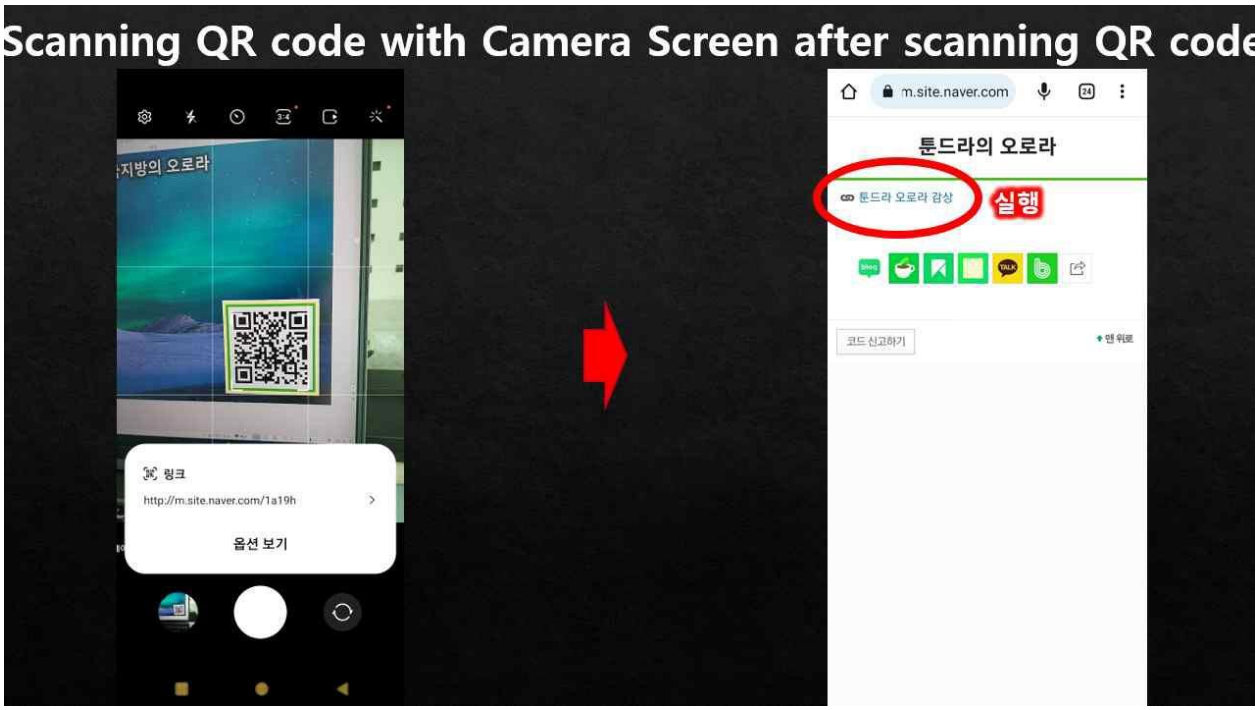
Scanning QR code with Daum App



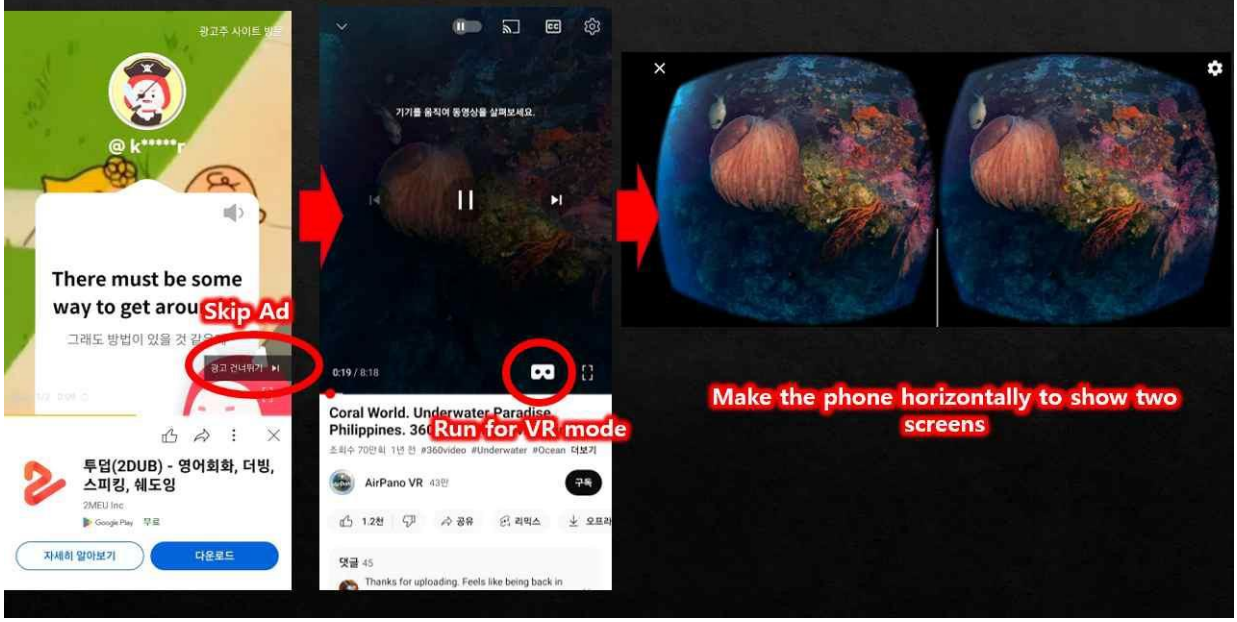
Scanning QR code with Kakao App



Scanning QR code with Camera Screen after scanning QR code



How to play 360-degree VR video of YouTube



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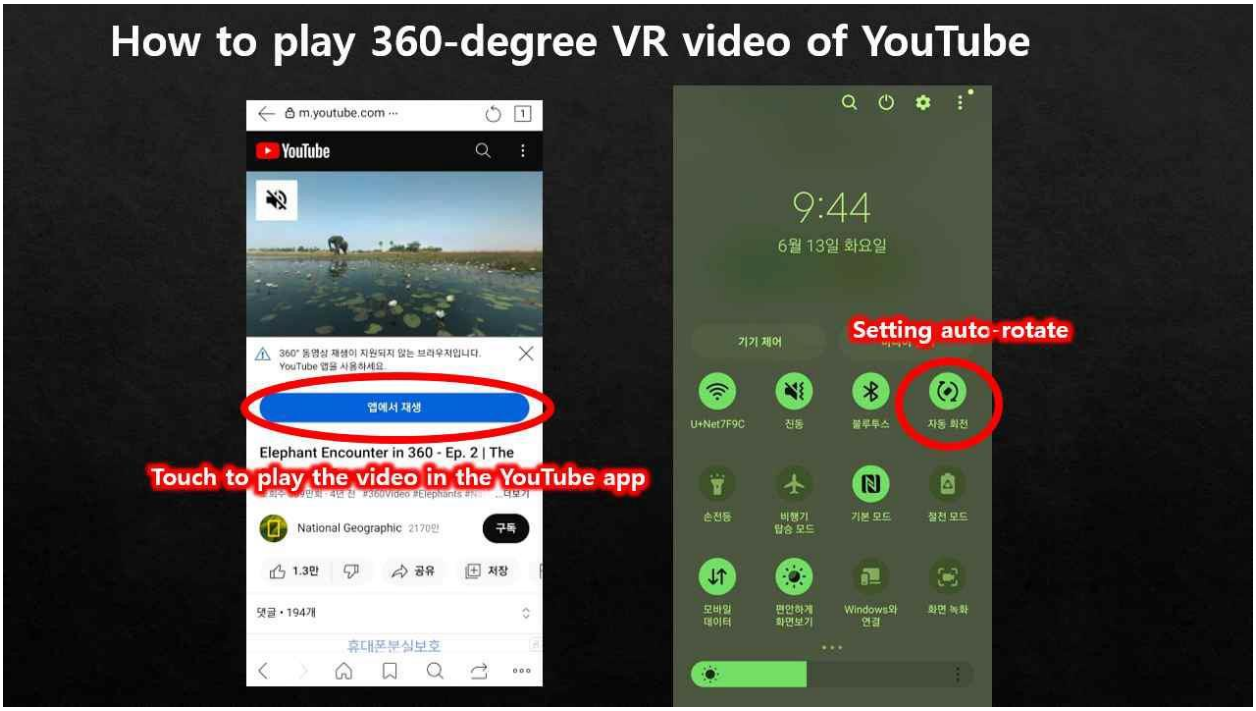
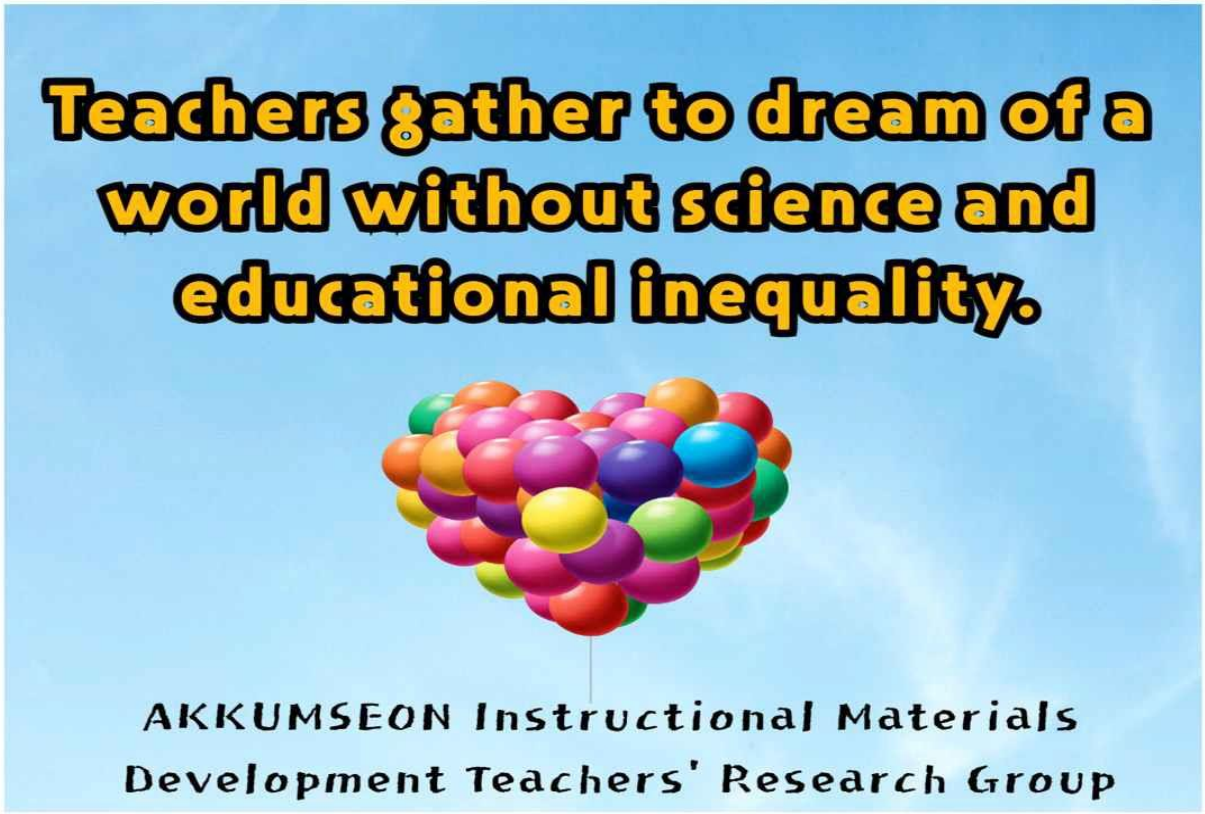


How to set up a mobile phone in VR headset


Hope you experience the mystery of nature realistically with VR
Thank you for attention



Mobile-Based Media Science Education Research

"Provide opportunities for learning anytime, anywhere."

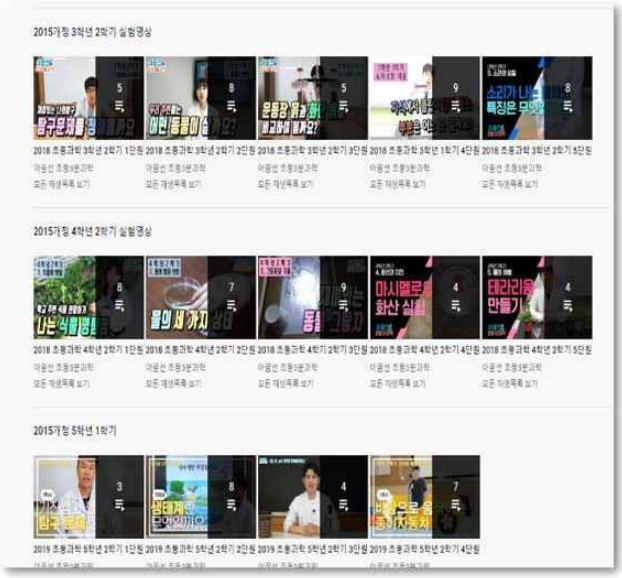
Upload science content for the curriculum.

Media-enhanced learning in the classroom

Currently 1000 science contents and 10 million views achieved on YouTube.

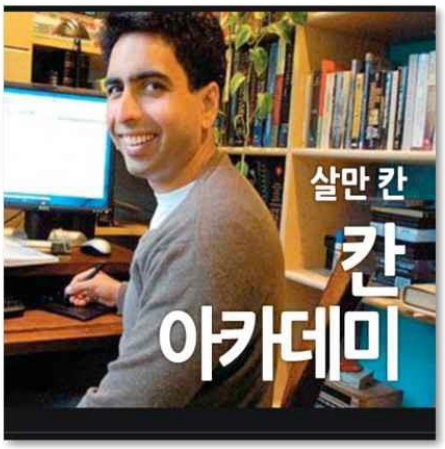
"1000 science experiment contents were created for elementary school science curriculum."

Currently, a total of 10 million views have been accumulated.



A world where everyone can enjoy and study science freely.

Free and quality education for all, everywhere.

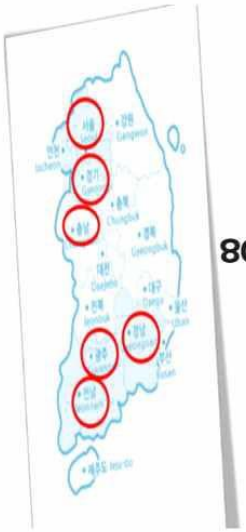


Experimental translation for students around the world who want to study"

To war refugees, African students, and children around the world who lack educational opportunities

Teachers' Growth Study Group

1 Passionate teachers' gathering



80 current teachers and education students

2 Professional development efforts

3 Science service for the underprivileged student.

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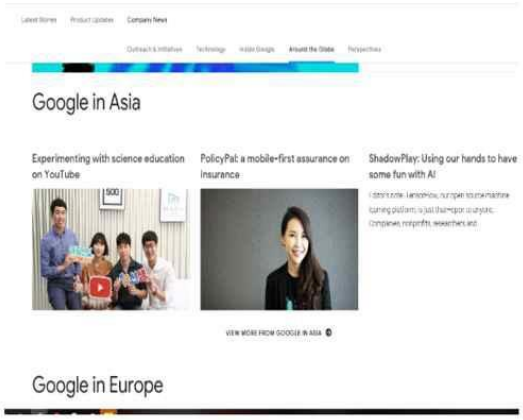
1 **Google Asia's representative educational creator**



2 **YouTube Korea's Creator of the Month**

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교보교육재단, 2020년 제22회 교보교육대상 시상식 개최

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Everyone should have an equal chance to get an education, regardless of their birthplace.

Development and Application of a Case-Based Reasoning Instructional Model using Expert System of Artificial Intelligence for STEAM

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Abstract

The purpose of this study is to investigate the effects of the case-based reasoning instructional model using expert system of artificial intelligence. Results suggest that students showed interest because it allowed them to find the solution to the problem and solve the problem for themselves by analogy from other cases such as crossword puzzles in an aspect of students' awareness of the designed model using technological expert system. This means students are motivated to study and the process of selecting and organizing educational content and teaching methods has to focus on students' active construction of knowledge. Therefore, the case-based reasoning instructional model can help researchers, teachers, and curriculum developers better understand students' process of learning and developing scientific knowledge about climate change.

1. INTRODUCTION

With the curriculum reform in 2009, the Ministry of Education, Science, and Technology in Korea now requires high school earth science courses to incorporate issues and scientific ideas concerning climate change (MEST, 2009). In order to understand the climate change phenomena, an ability to deal with uncertainty on several levels is necessary. The interdisciplinary and complex nature of climate change science results in an abundance of ill-defined problems, and finding solutions to such problems requires skills that go beyond the relatively constrained problems generally presented in science textbooks (Schraw et al., 1995). Ill-defined or ill-structured problems are those that begin without all the information necessary to develop a solution or even to precisely define the problem, have no single right approach for a solution, have problem definitions that change as new information is gathered, and have no identifiable "correct"solution (Gallagher et al., 1995). Therefore, as climate change is a complex issue with different roots and many ramifications, learning about climate change requires students to exercise scientific reasoning skills, such as understanding, thinking, researching, and criticizing.

However, the traditional science teaching model overlooks the importance of students' reasoning processes regarding socio-scientific issues, such as climate change (Schraw et al., 1995). Developing an effective learning model that elevates students'reasoning ability has become a critical issue in recent science education. Traditional science instruction has tended to exclude students who need to learn from contexts that are based in the real world, graspable, and self-evidently meaningful. In turn, Kolodner et al. (2006) found out that the case-based reasoning process encourages students toactively participate in solving a problem through an appropriate cognitive conflict and reasoning process by making them solve the problem through inductive reasoning that is based on past experiences like a process of expert system of artificial intelligence. However, this approach is not perfect in that its procedural stage needs to be more concrete (Kolodner et al., 2006).

Therefore, an objective of this study is develop a learning model using expert system of artificial intelligence based on the case-based reasoning process like expert system, see how the model influences students'understandings of climate change, as well as determine how students perceive case-based learning in their classes.

2. RESEARCH OBJECTIVES AND METHODOLOGY

Having outlined the importance of the case-based reasoning theory, the objectives of this study are: 1) To develop a case-based reasoning instructional model using expert system focused on climate change for a high school Earth Science class in Korea. 2) To study how students make sense of case-based reasoning approaches in regards to problem solving in earth science class.

3. Participants

Twenty-eight sophomores from one science track class in an academic high school in Gyeong-gi province, Korea were chosen and the students participated voluntarily.

4. Data collection

Based on the theoretical frames and conditions of the case-based reasoning instructional model found in the advanced research, a designing process of the instructional model was conducted according to the research's basic procedure as follows. First, an initial case-based reasoning instructional model was designed, as shown, based on theoretical considerations of case-based reasoning and research of science instructional models. Second, the validity of the designed model was determined by experts in science

education and applied in a school setting through discussing the strengths and weaknesses of the model. The field application was conducted by 28 sophomores from one science track class in an academic high school in Gyeong-gi province of Korea during 7 lessons of the Earth science I class (total 275 minutes) in the second semester of 2012. After the class ended, the participants were asked to answer a questionnaire about the lesson, and three days after the class, a semistructured one-to-one interview was conducted. Through the analyzed result about the interview contents, the first modified case-based reasoning instructional model was suggested. Third, the validation method of the contents about the first modified case-based reasoning instructional model was used by experts'review used in validation of a model or an investigating tool in general research. In the other words, the experts' review method suggested the model and assessed it by asking questions to the researcher using a simple checklist. The researchers who participated in the review were 5 experts who work in science education, 3 of whom were doctors and 2 of whom were in the middle of the doctor's course. This procedure enables experts to evaluate the accuracy of the research process and results because it gives an inter-rater reliability of the study (Lincoln & Guba, 2000). Based on the merits and demerits and improvement points of the instructional model determined through this validation process of the model, the second modified case-based reasoning instructional model was developed.

5. Data Analysis

This study transcribed the interviews of twenty-eight students and divided the content into sentences. The interview materials were classified as A~Z, A′~B′ and coded based on the main questions. These coded materials were classified as upper category by collecting similar coding through an inductive category. Thus the participants' interview material was analyzed by the inductive category based on the meaning and necessity of case-based reasoning.

6. RESULTS AND DISCUSSION

Designing the case-based reasoning instructional model

This research suggested the final designed case-based reasoning instructional model as follows: The first stage of the case-based reasoning instructional model is "presentation of a problematic situation", the main activity of which is to attract learners to try to problem-solve the problematic situation by outlining the situation after introducing the lesson and motivating the students to engage in the learning process. The second stage is "search for cases", through which students search for former cases, including others'

experiences, as a method to solve the problem and find clues to solve it within the content of the problem. The third stage is "use of case". It is the stage where the problem-solving method and solution are determined by modifying the concepts and principles related to regularity found in the case and building a hypothesis. The fourth stage is "modification of case and problem solving". In this stage, the solution of a former case is verified and if the case is not appropriate to solve the problem, the former case is modified and the problem is solved. But it is the stage to find the other case necessary to solve the problem again if not solving it. The fifth stage is "application and generalization". This stage stands for application and generalization and can be invoked to indicate what has been solved, the outcome, solution, or conclusion, which is included the next steps toimplement development of the idea.

7. The effect of application of the case-based reasoning instructional model

This research attempted to consider case-based reasoning theory to design a case-based reasoning instructional model based on theory and check for the application effect in a school setting. The results are as follows:

8. Meaning of case-based reasoning

Students recognized the meaning of case-based reasoning as three big categories: a process solving problems by using cases of experience, a process ofreconstructing knowledge through mutual a exchange of opinions, and a process of solving a problem by inference.

9. Necessity of case-based reasoning

Participants think that case-based reasoning is necessary in science class because it makes concepts change, expands students' knowledge, and increases problem-solving skills and thinking skills.

10. Use of the case-based reasoning lesson

68% of students expressed that they will use the case-based reasoning lesson often because it is a process to understand new knowledge and to solve a problem through a list of cases. However, 32% of students thought that they would not use the lesson because of the difficulty of sharing the group members' opinions, unsatisfactory experiences, the strange teaching method, and the difficulty of the science class.

11. Difficulties in using the case-based reasoning lesson

Students participating in the lesson listed the difficulties of using case-based reasoning lesson as the following: a lack of understanding about case analysis, a lack of interest in participating in the discussion, the limited class time, a lack of knowledge about cases of experience, and insufficient teacher's help.

12. CONCLUSIONS AND IMPLICATIONS

This research considered case-based reasoning theory, designed a case based reasoning instructional model based on theory, and checked for the application effect in a school setting. The 5 stages and 13 subcomponents of process were presented. Also, the results of this study contribute significantly to our understanding of both the students'experience in using case-based reasoning and how students perceive it assists their learning in the subject about climate change. To summarize the discussion thus far, the case-based reasoning lesson is an instructional model based on expert system to find out what students know and to determine the appropriate cognitive strategy to check, to evaluate, and to control cognitive problem-solving processes by expert system. Therefore, this study can help students' learning and reasoning thinking processes as it promotes the development of curriculum and educational materials based on understandings of the case-based reasoning instructional model using expert system of artificial intelligence.

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Table 1. Main instructional strategies in stages of case-base reasoning instructional model

Stage	Procedure	Main teaching strategy
Presenting a problematic situation	Introducing a lesson	1. Presenting the whole process of the case-based reasoning class specifically through the introducing lesson
	Motivating learning	2. Giving an opportunity for learners to expand their cognitive str ucture through areas of interest or concern
	Presenting a problematic situation	3. Giving an opportunity for learners to participate in problem-so lving processes initiatively by presenting a practical problematic situation
Search for cases	Recognizing a problem	4. Providing an opportunity for students to recognize the problem of a presented problematic situation or phenomenon
	Searching for cases	5. Providing an opportunity to search for suitable cases by writing in former cases necessary to solve the problem (scaffolding) 6. Using a strategy to arrange opinions suggested by students based on similarities 7. Providing an opportunity to provoke a range of ideas as creativ ity and to search for former cases including others' experiences a s a method to solve the problem
	Thinking of problem solving methods	8. Providing an opportunity for group discussion for students to t hink about a problem-solving method by themselves
Use of case	Using a former case in problem solving	9. Providing an opportunity to find similar former cases, namely providing a clue to solve the problem by themselves 10. Providing an opportunity to determine if the cases used in pro blem solving are based on a hypothesis with appropriate grounds and claims
	Presenting a solution	11. Providing an opportunity for students to present a solution (h ypothesis) through an elaborating process
Modifying the case and problem solving	Verifying a solution	12. Providing an opportunity to verify their solutions and speak t heir opinions through each group's presentation
	Modifying a former case	13. Providing an opportunity to modify diverse variables and cha nge the case such that it is suitable for solving the problem if the case is not appropriate to solve it
	Deciding whether or not to search for a case	14. Providing an opportunity for students to judge if there is a ne ed to search for a new case by using their own problem-solving j udgment
Application and generalization	Checking for the solved case	15. Providing an opportunity for students to check for the former case that learned by process of solving the problem
	Applying the case to a new situation	16. Giving an opportunity to apply it to new problematic situatio n based on the useful former case used in problem solving

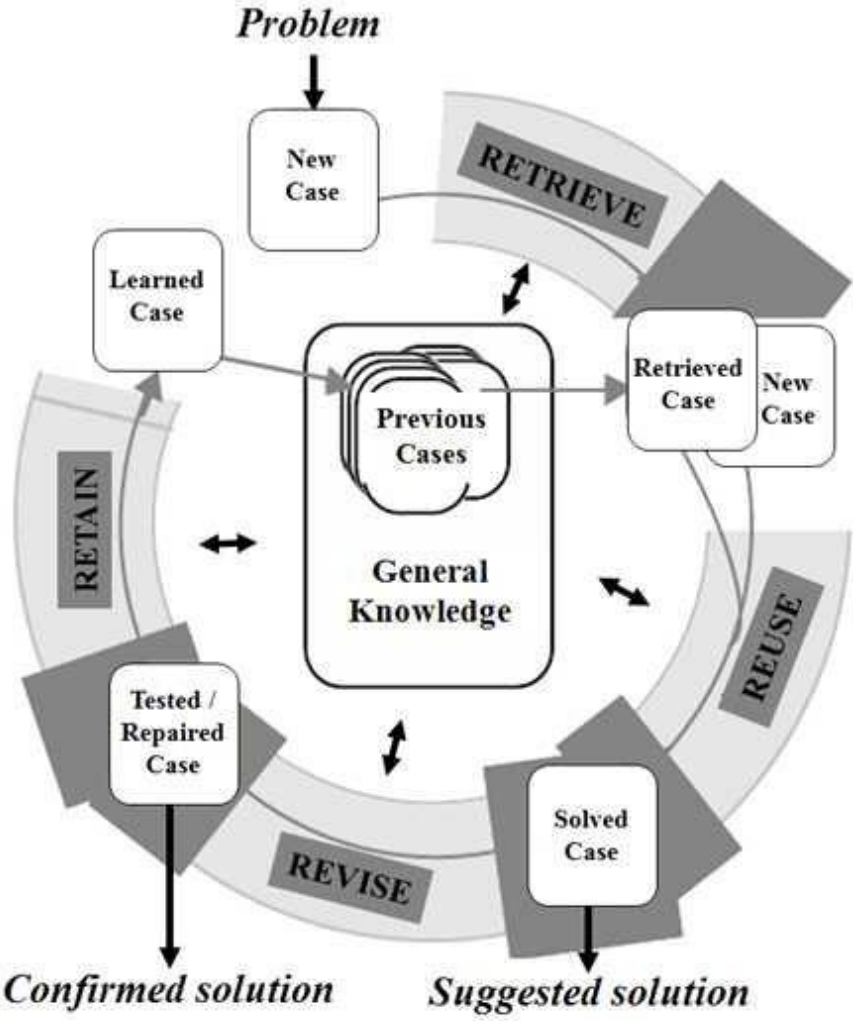

Figure 1. The process of case-based reasoning (Aamodt & Plaza, 1994)

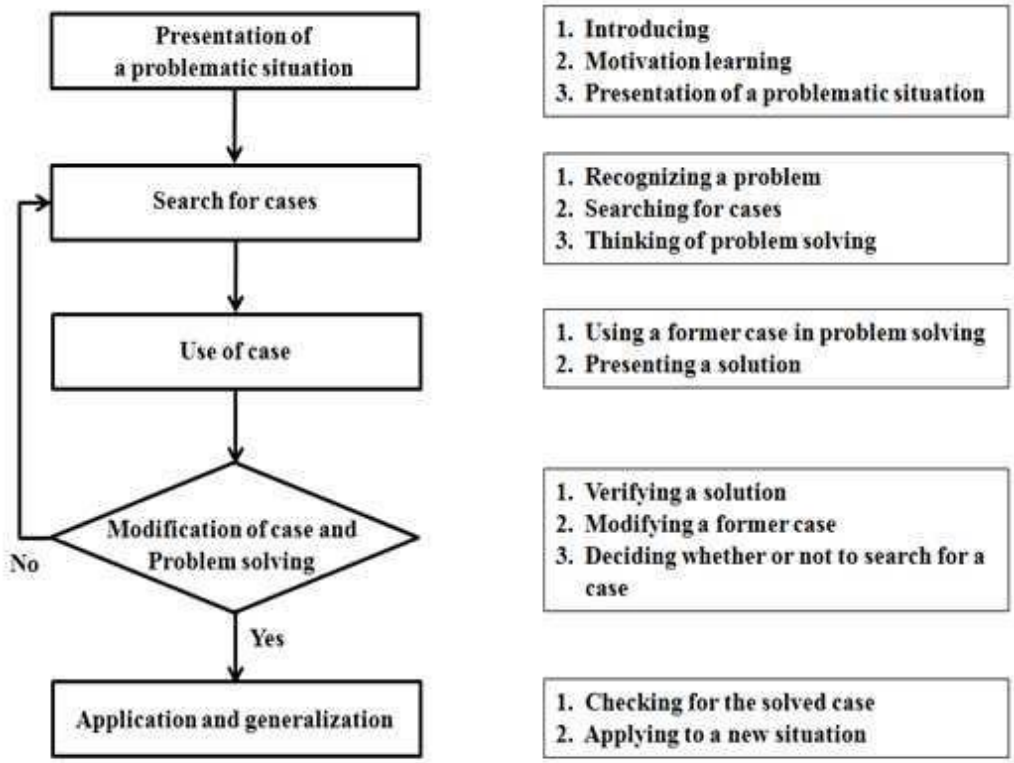

Figure 2. Designed case-based reasoning instructional model

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