JAPANESE SCIENCE EDUCATION

NEW COURSE OF STUDY IN JAPAN

Kiyoyuki OHSHIKA, Professor
Aichi University of Education

Ki yoyuki OHSHIKA
Aichi University of Education

Professor
Towards a sustainable society
Think about the future, not now

2020  new corona virus pandemic
2030  12 yrs. After  How old will you be?
2040  22 yrs. After  What will your life be like?
2100  82 yrs. After  How your world will look like?
2112  94 yrs. After  Doraemon will born
Japanese School Curriculum

- Course of Study was issued every 10 years as school curriculum in Japan
- The Period for Integrated Studies was started from 1989 revised version
- The Period for Integrated Studies from 3\textsuperscript{rd} grade in ES to High School

Living unit learning  systematic learning  Inquiry  Living Environment Studies Period for Integrated Studies  Key Competency

Key words of this revision

• Key competency
• Active Learning
• Curriculum Management
Direction of revision of course of Study

Fostering the qualities and abilities required for a new era

What can we do

- Reinforcement for learning and humanity
- Learning knowledge and skills
- Training thinking ability, judgment ability, expression power, etc.

How to learn

Subjective and collaborative learning toward discovering and solving tasks <Active Learning>

Realization of "Curriculum Opening to Society"

Establishment of curriculum management at each school

What to learn

Establishment of subjects, courses, etc., review of target / contents

How to learn

Subjective and collaborative learning toward discovering and solving tasks <Active Learning>
Basic Idea of New Curriculum

- More reliable development of qualities and abilities for children to open up a future society

We emphasize "educational curriculum opened to society" that shares what sort of qualities and abilities required for children to live with society and cooperate

- To enhance the quality of understanding of knowledge and nurture qualities and abilities

  Clarify "subjective · interactive and deep learning" and "what will become possible"

  Improvement of class based on accumulation of educational practice in our country

- Establishment of curriculum management at each school
Review of framework of course of study

①「What can we do」 (Ability and ability to develop)

②「What to learn」 (Significance of learning subjects, and organization of educational curriculum based on connection between subjects and school stages)

③「How to learn」 (Preparation and implementation of Lesson plans for each subject, Improvement and enhancement of learning and guidance)

④「How to support each child's development」 (Teaching based on child's development)

⑤「What did you learn」 (Enrichment of learning evaluation)

⑥「What is necessary for implementation」 (Necessary strategy to realize the philosophy of Course of Study)

- (Fundamental improvement of general rules for sharing ideas of new Course of Study)
Realization of subjective, interactive and deep learning
(Improvement of class from the viewpoint of "active learning")

【Deep Learning】 【Interactive Learning】
【Subjective Learning】
WHAT IS KEY COMPETENCY?

Key competencies are not determined by arbitrary decisions about what personal qualities and cognitive skills are desirable, but by careful consideration of the psychosocial prerequisites for a successful life and a well-functioning society (OECD).

Competency Category 1: Using Tools Interactively

社会・文化的、技術的ツールを相互作用的に活用する能力

Competency Category 2: Interacting in Heterogeneous Groups

多様な社会グループにおける人間関係形成能力

Competency Category 3: Acting Autonomously

自律的に行動する能力
REALIZATION OF PROACTIVE, INTERACTIVE AND DEEP LEARNING 「ACTIVE LEARNING」

【Deep Learning】
“Deep learning” that leads to a deep understanding of the learning content by thinking, judging, and expressing

【Interactive Learning】
“Interactive learning” that broadens and deepens one’s own thoughts through collaboration among children, dialogue with teachers and local people, and thinking of preconceptions as clues

【Subjective Learning】
“Self-directed learning” in which students have an interest and interest in learning, work persistently with a perspective, look back on their learning activities, and connect them to the next
Studies show that varying your study methods and materials will improve your retention and recall of information, and enhance your learning experience. The "learning pyramid", sometimes referred to as the "cone of learning", developed by the National Training Laboratory, suggests that most students only remember about 10% of what they read from textbooks, but retain nearly 90% of what they learn through teaching others. The Learning Pyramid model suggests that some methods of study are more effective than others and that varying study methods will lead to deeper learning and longer-term retention.
<table>
<thead>
<tr>
<th>Area</th>
<th>Characteristic viewpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Capture natural things and phenomena mainly from a quantitative and relational viewpoint</td>
</tr>
<tr>
<td>Particle</td>
<td>Capture natural things and phenomena mainly from a qualitative and substantial viewpoint</td>
</tr>
<tr>
<td>Life</td>
<td>Capture natural things and phenomena concerning life mainly from a diversity and commonality</td>
</tr>
<tr>
<td>Earth</td>
<td>Capture natural things and phenomena about the earth and the universe mainly from a temporal and spatial viewpoint</td>
</tr>
</tbody>
</table>
Scientific Inquiry process

1. Question to Natural phenomena
2. Setting a Task/Problem
3. Setting a Hypothesis
4. Planning for experiments
5. Do observation
6. Do experiments
7. Collect Data/Interpretation
8. Collect Data/Interpretation
9. Consideration/Conclusion
10. Expression/Communication

(prospect) → review
Objective of Elementary Science

Foster the qualities and abilities necessary to scientifically solve problems related to natural things and phenomena through familiarity with nature, observing science, and observing and conducting experiments with a perspective. Aim for that.

(1) To understand natural things and phenomena and acquire basic skills related to observation and experiments.

(2) Observe and experiment to develop the ability to solve problems.

(3) To develop a feeling of loving nature and an attitude to solve problems independently.

(1) Knowledge/Skill

(2) Thinking/ Judgement/ Expression

(3) Want to Learn/ Humanity
Objective of Middle Science

Foster the qualities and abilities necessary for scientifically exploring natural things and phenomena through observing and experimenting with perspectives by engaging in the perspectives and ways of thinking of science related to natural things and phenomena. Aim to do.

(1) To deepen understanding of natural things and phenomena, and acquire basic skills related to observation and experiment necessary for scientific research.

(2) To cultivate the ability to conduct scientific research by conducting observations and experiments.

(3) To develop an attitude of exploring scientifically by being willing to be involved in natural things and phenomena.
## Characteristic View in Each Area of Science (Viewpoints of Science)

<table>
<thead>
<tr>
<th>Energy</th>
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<th>Life</th>
<th>Earth</th>
</tr>
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</table>

## Way of Thinking in Science

<table>
<thead>
<tr>
<th>3rd Grade</th>
<th>4th Grade</th>
<th>5th Grade</th>
<th>6th Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding and expressing problems based on differences and common points in pursuing natural things and phenomena (through activities for comparison and investigation).</td>
<td>In pursuit of natural things and phenomena (through activities related to them), inspiring and expressing valid predictions and hypotheses based on the contents of previous lessons and life experiences</td>
<td>While pursuing natural things and phenomena (through activities that control and control conditions), think and express a solution method based on expectations and hypotheses.</td>
<td>Creating and expressing a more appropriate idea while pursuing natural things and phenomena (through activities for multifaceted investigation).</td>
</tr>
</tbody>
</table>
CHARACTERISTIC VIEW IN EACH AREA OF SCIENCE (VIEWPOINTS OF SCIENCE)

<table>
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</tr>
</tbody>
</table>

WAY OF THINKING IN SCIENCE

The process of scientific inquiry

1st Grade
- Finding problems
- Conduct observations, experiments, etc. with a prediction
- Finding and expression [regularities, relationships, common points and differences, viewpoints and criteria for classification]

2nd Grade
- Observe, experiment, etc. by designing a method to solve with a prediction
- Analyzing and interpreting the results and finding and expressing [regularity and relationship]

3rd Grade
- Observe, experiment, etc. with a prediction
- Analyzing and interpreting the results (or materials) and finding and expressing [features, regularities, relationships]
- Reflecting on the process of inquiry
<table>
<thead>
<tr>
<th>Grade</th>
<th>Division A Matter/Energy</th>
<th>Division B Life/Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd</td>
<td>(1) Objects and weight</td>
<td>(1) Living creatures</td>
</tr>
<tr>
<td></td>
<td>(2) Function of wind and rubber force</td>
<td>(2) State of the sun and the ground</td>
</tr>
<tr>
<td></td>
<td>(3) Properties of light and sound</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4) Properties of magnet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5) Passage of electricity</td>
<td></td>
</tr>
<tr>
<td>4th</td>
<td>(1) Properties of air and water</td>
<td>(1) Human body construction and exercise</td>
</tr>
<tr>
<td></td>
<td>(2) Metal, water, air and temperature</td>
<td>(2) Season and creature</td>
</tr>
<tr>
<td></td>
<td>(3) Function of current</td>
<td>(3) Whereabouts of rainwater and the state of the ground</td>
</tr>
<tr>
<td>5th</td>
<td>(1) How to melt things</td>
<td>(1) Germination, growth and fruiting of plants</td>
</tr>
<tr>
<td></td>
<td>(2) Pendulum movement</td>
<td>(2) Birth of animals</td>
</tr>
<tr>
<td></td>
<td>(3) Magnetic force created by electric current</td>
<td>(3) Function of flowing water and change of land</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4) Changes in weather</td>
</tr>
<tr>
<td>6th</td>
<td>(1) Combustion mechanism</td>
<td>(1) Structure and function of human body</td>
</tr>
<tr>
<td></td>
<td>(2) Properties of aqueous solution</td>
<td>(2) Pathway for plant nutrients and water</td>
</tr>
<tr>
<td></td>
<td>(3) Lever regularity</td>
<td>(3) Life and environment</td>
</tr>
<tr>
<td></td>
<td>(4) Use of electricity</td>
<td>(4) Construction and change of land</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5) Moon and sun</td>
</tr>
<tr>
<td>Field I</td>
<td>Matter / Energy</td>
<td>Field II</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>1st G</td>
<td>(1) familiar physical phenomena</td>
<td>(1) Various creatures and their common points</td>
</tr>
<tr>
<td></td>
<td>(A) Light and sound</td>
<td>(A) How to observe and classify living things</td>
</tr>
<tr>
<td></td>
<td>(B) power work</td>
<td>(B) Common points and differences between living organisms</td>
</tr>
<tr>
<td></td>
<td>(2) Substances around us</td>
<td>(2) Formation and change of the earth</td>
</tr>
<tr>
<td></td>
<td>(A) The substance</td>
<td>(A) Observation of familiar topography, strata, and rocks</td>
</tr>
<tr>
<td></td>
<td>(B) Aqueous solution</td>
<td>(B) Overlapping strata and past conditions (c) Volcano and earthquake</td>
</tr>
<tr>
<td></td>
<td>(C) State change</td>
<td>(C) Nature's blessing and volcanic disaster/earthquake disaster</td>
</tr>
<tr>
<td>2nd G</td>
<td>(3) Current and its use</td>
<td>(3) Structure and function of living body</td>
</tr>
<tr>
<td></td>
<td>(A) Current</td>
<td>(A) Living organisms and cells (B) Plant body structure and function</td>
</tr>
<tr>
<td></td>
<td>(B) Current and magnetic field</td>
<td>(B) Structure and function of animal body</td>
</tr>
<tr>
<td></td>
<td>(4) Chemical changes and atoms/molecules</td>
<td>(4) Weather and its changes</td>
</tr>
<tr>
<td></td>
<td>(A) Origin of substance</td>
<td>(A) Meteorological observation (B) Weather change (C) Japanese weather</td>
</tr>
<tr>
<td></td>
<td>(B) Chemical change</td>
<td>(B) Blessing of nature and meteorological disaster</td>
</tr>
<tr>
<td></td>
<td>(C) Chemical change and mass of substance</td>
<td></td>
</tr>
<tr>
<td>3rd G</td>
<td>(5) Exercise and energy</td>
<td>(5) Continuity of life</td>
</tr>
<tr>
<td></td>
<td>(A) Balance of power and synthesis/disassembly</td>
<td>(A) Growth and breeding of living things</td>
</tr>
<tr>
<td></td>
<td>(B) Regularity of exercise (c) Mechanical energy</td>
<td>(B) Genetic regularity and genes</td>
</tr>
<tr>
<td></td>
<td>(6) Chemical changes and ions</td>
<td>(C) Diversity of species and evolution</td>
</tr>
<tr>
<td></td>
<td>(A) Aqueous solution and ion (b) Chemical change and battery</td>
<td>(6) Earth and space</td>
</tr>
<tr>
<td></td>
<td>(7) Science and technology and humans</td>
<td>(A) Movement of celestial bodies and rotation/revolution of the earth</td>
</tr>
<tr>
<td></td>
<td>(A) Energy and materials</td>
<td>(B) Solar system and stars</td>
</tr>
<tr>
<td></td>
<td>(B) Conservation of natural environment and utilization of science and technology</td>
<td>(7) Nature and humans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(A) Life and environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(B) Conservation of natural environment and utilization of science and technology</td>
</tr>
</tbody>
</table>
ポージング クエスチョン

予想

計画

実験

１．ホウセンカを挿し立てて
根を洗う。
２．植物染色液を三角フラスコに
入れ、ホウセンカを入れて、
根を水に浸す。
３．植物染色液の水面の位置を
観察する。
４．葉や根の色、水の水面の位置が
変化していくように観察する。

注意
カッターナイフで
葉を切らない
ようにする。

だっし繩

初めの
水面の位置
Results

Discussion

Conclusion
実施段階
「理数探究（仮称）」

基礎段階
「理数探究基礎（仮称）」

探究を深める段階
- 基礎で身に付けた資質・能活力を活用して自ら課題を設定し、探究の過程全体を行う。
- それぞれの課題に応じた探究を行うために必要な個別の知識や技能を主体的に身に付けさせ、より深い探究を志向させる。
- 探究に当たっては、質を高めるため大学・企業等の外部機関を積極的に活用する。
- 実験や分析自体の成否より、試行錯誤し、失敗のリスクを引き受けながら主体的にやり遂げる過程を重視する。

基礎の習得段階
- 探究の過程全体を自ら遂行するために基礎となる資質・能力をあらかじめ身に付けておくことが必要。
- 新たな価値の創造に向けて挑戦することの意義等について理解を深めさせることで、主体的に探究に取り組む態度を身に付けてさせることが必要。
- 研究倫理等についての基本的な理解を身に付けさせることが必要。

学習過程の例
- 探究の手法について学ぶ
- 教員の指導のもと、実験・観察の進め方や分析の手法を考え、選択した課題等の探究を実施する
- 研究倫理についての基本的な理解のための学習

大学・企業等からの支援
- 基礎で学んだことを用いて、自ら課題を設定し、探究の過程全体を実施する。
- 校内・校外において探究の成果を発表する。
SUSTAINABLE DEVELOPMENTAL GOALS (SDGs)

2015年国連で採択  2030年に向けけて「誰一人取り残さない」を目指した全員の目標

①貧困をなくす  ②飢餓をなくす  ③健康であること  ④質の高い教育  ⑤ジェンダーの平等  ⑥清潔な水と衛生  ⑦再生可能エネルギー  ⑧適切な労働と経済成長  ⑨新しい技術とインフラ  ⑩不平等をへらす  ⑪持続可能街と地域社会  ⑫責任ある消費  ⑬気候変動  ⑭海をまもる  ⑮陸のいのちをまもる  ⑯平和で公正な社会  ⑰目標のための協力
### 環境

<table>
<thead>
<tr>
<th>目標</th>
<th>飢餓をゼロにする</th>
<th>安全な上下水の保障</th>
<th>安全で災害に強いまちづくり</th>
<th>気候変動対策</th>
<th>海の豊かさ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>食べ物から見える世界、5年これからの食料生産とわたしたち</td>
<td>4年水を守れアースレジャー</td>
<td>5年地域安全マップをつくろう今やろう、地震への備え</td>
<td>5年 カーボンマイナス子どもアクション</td>
<td>5年</td>
</tr>
<tr>
<td>7</td>
<td>エネルギーをみんなにクリーンにする</td>
<td>産業と技術革新の基盤づくり</td>
<td>こみと私たちのくらし</td>
<td>陸の豊かさ</td>
<td></td>
</tr>
<tr>
<td>5年エネルギー基盤整備</td>
<td>5年エコプロダクション参加環境の視点で工業を見直そう</td>
<td>4年これからの食料生産とわたしたち</td>
<td>1年生き物となかよし、2年せきせいていがいしん、3年やりがいのある育て方、4年サリガニの食べる</td>
<td>水産業、岩井臨海学校（遠泳・地引き網・プランクトン）</td>
<td></td>
</tr>
</tbody>
</table>

### 人権

<table>
<thead>
<tr>
<th>目標</th>
<th>貧困をなくす</th>
<th>健康と福祉</th>
<th>ジェンダープラチノの実現</th>
<th>平和で公正な社会と行政</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>食べ物から見える世界、5年これからの食料生産とわたしたち</td>
<td>3年、食べ物から見える世界、5年これからの食料生産とわたしたち</td>
<td>4年やさしさパワーアップ大作戦（車いすバスケット、介護体験等）、4年大きくなってきた私（2分の1・成人式）</td>
<td>6年未来へ羽ばたけ（キャリア教育の視点から）</td>
</tr>
<tr>
<td>2</td>
<td>どこでもすぐに市探検、町のひみつを知らせたい</td>
<td>3年 父の思いを伝えたたい</td>
<td>4年さそう深川未来遺産</td>
<td>5年江戸・深川の町を語ろう</td>
</tr>
</tbody>
</table>

### 多文化理解（国際理解）

<table>
<thead>
<tr>
<th>目標</th>
<th>人や国家間の平等</th>
<th>世界の協力とパートナーシップ</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2年どきどきわくわく町探検、町のひみつを知らせたい</td>
<td>2年 あしたヘジャング</td>
</tr>
</tbody>
</table>

※ 人である国である、平等なつきあいを進めるためには、相互理解が基盤となる。多様な文化理解が異質への対応や、平等な人間関係の基盤である。
つながら学ぶ

八名川版

ESD

どちらを身に付けるか

どんな力を身に付けるか

学びを深める教科横断的な学びの構築
(ESDカレンダーの充実)

子どもたちが生きていく時代を踏まえた社会的な課題

何を学ぶか

主体的に学ぶ

どのような学ぶか

対話的に学ぶ

学校教育目標『自ら学び考え行動する子』

心のある子（多様な人と共創する力）

進のある子（科学に関する発表・討論する力）

転のある子（物事に挑戦しようとする力）

どんな力を身に付けるか


curriculum management for school
環境に関すること
（No.6, 13, 14, 15）
Creativity is just connecting things. (Steve Jobs)
Characteristic description related to acquiring of thinking ability, judgment ability, expression power in the course of study of elementary school science

Thinking skill, judgment, expressive power that emphasizes mainly in each grade

3rd Grade: (Through activities to examine while comparing)
   Based on differences and similarities, find and express problems

4th Grade: (Through activities to investigate while relating)
   Based on the content of the exercise and living experience, thinking and expressing grounds and expectations and hypotheses

5th Grade: (Through activities to examine while controlling conditions)
   Based on expectations and hypotheses, think and express ways of solution

6th Grade: (Through activities to research multifacetedly)
   Create and express a more reasonable idea
Characteristic description related to acquiring of thinking ability, judgment ability, expression power in the course of study of junior high school science

- Organize the learning process that focuses mainly on each grade to acquire qualities and abilities

7th Grade: Involving in natural things and phenomena, and find problems from among them

8th Grade: Plan how to solve, analyze and interpret the results

9th Grade: Reviewing on the process of Inquiry
Evaluation/ Objective

Now
- Interest / Motivation / Attitude
- Knowledge and Understanding
- Scientific Thinking and Expression
- (Experimental) Skill

Next
- Scientific Knowledge and Skill
- Scientific Thinking, Decision and Expression
- Power and Interest for learn, humanity