



CoREF, The University of Tokyo

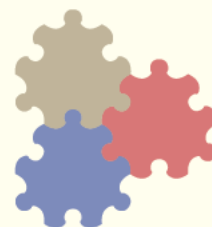
message

Learning is
changing our own way of thinking
little by little
and continuing to become wiser
through interactions with others.

We do not yet know the true wisdom of ourselves.
We do not know how to make people truly wise,
because
we have never properly looked at
the process of becoming wiser.

Now, little by little,
the process by which people make themselves wise
through thinking by themselves,
has become possible to trace in detail.
From here, a new science of learning begins

We really like to think by ourselves.
We remember for a long time
and are able to develop by ourselves
what we had thought up by ourselves.

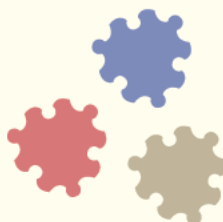


The University of Tokyo

Center for research and development
on transitions from secondary education
to higher education

**Division of cross-stage education
and assessment**

Academic ability and 21st century skills improvement project
in collaboration with the boards of education
New type of secondary education
and higher education collaboration model project



Learn a lot.
Make a friend who thinks.

Seeking new learning

Today, society needs to nurture intellectual abilities through which individual learners are able to cultivate their own way of thinking throughout their lives, and to make full use of their thinking skills, problem solving skills, decision-making skills and expression skills. CoREF provides the means to develop such intellectual abilities using collaborative problem solving tasks.

Collaborative problem solving

People continue to develop their wisdom while interacting with others. If you explain something to others, they might not be convinced on all points and so you might reconsider your own thinking. If you are receptive to new viewpoints and pieces derived from the explanations given by others, and incorporate them into your own original thinking, the scope of your thoughts will expand. In our collaborative project, we help convert a classroom into a collaborative problem solving place so that these constructive interactions may more easily occur. Through the process of dialogue during which children identify “the questions that they want to answer and the necessary pieces in order to be able to answer the questions” and create answers by getting together with classmates who are in charge of different pieces, they come close to thinking and ideas which they personally find persuasive.

In such classes, each child creates his or her thinking, expressing it in a different form many times in the same one lesson and they experience for themselves that, “When I solve problems with others, my ideas get better.” Since they are trying to create the same answer, the expressions and thinking of other children prove to be helpful. Such experiences help nurture the ability to collaboratively solve problems through the process of “engaging in dialogue while thinking.”



The 21st century skills

We believe that 21st century skills are intellectual skills that everyone potentially possesses where people become wiser through interacting with others. People naturally have the ability to notice a problem, the ability to tell people what they want to say, the ability to learn from others, the ability to find new answers, and the ability to look back on their methods and to try to make things better. What is important in the 21st century is to be able to select these skills by ourselves, to be able to use them to a certain degree, and where necessary, to relearn them. To this end, it is necessary to accumulate experiences where people express and change the form of what they want to express over and over again, and try to revise their answers incorporating the explanations given by others in a setting where they can use these skills consciously every day, and if this is in the context of a classroom, where children will be able to create answers by themselves.

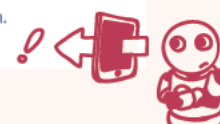
Through everyday use, we are able to use to some extent the various skills referred to as 21st century skills and it becomes possible to distinguish which ones suit us and which do not. Through frequent experience of collaborative problem solving tasks in the classroom and conscious use of communication skills, metacognition skills, thinking skills, decision-making skills, and expression skills, etc., children naturally develop “the sense of having been able to create a new answer.” This leads to the development of innovation skills.



ICT literacy

ICT is a tool to aid learning. People become better little by little at using convenient things which are used on a daily basis through observing others and making their own adjustments. What is important is whether the quality of learning can be improved through using ICT. In collaborative problem solving, changes in the quality of learning can easily be seen. If every child is given a tablet in a collaborative class, opportunities increase for each individual child to express his or her thoughts in the classroom, view them from the outside, remake them, and view them again. Since the things which a child tries out on a tablet are often seen by others, constructive interaction becomes easier. The past history of the learning can also be seen. This in turn will probably improve the quality of the lesson, and increase opportunities for each child to develop 21st century skills.

When we collect and analyze the learning processes of a large number of participants using the internet, although there are differences in the learning speed, there are very few participants who are unable to learn if they take their time. ICT which is used in classes that utilize a collaborative problem solving process is an effective means to record and analyze the process by which each child learns. By using ICT, it is possible to obtain a full picture of the class. It is also necessary to create an environment where such processes are fed back in a way that the teacher can look back at them.

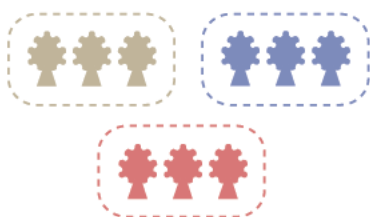


Knowledge Constructive Jigsaw method

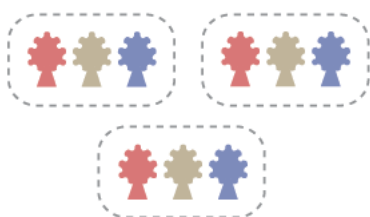
By repeating a series of activities such as expressing their ideas in their own words, listening to the explanations of others, and changing their ideas to achieve better understanding, it becomes possible for children to learn how to think and to learn by themselves. The Knowledge Constructive Jigsaw method is well-suited to introducing collaborative learning into ordinary classrooms, because of its clarity and ease of use enabling diverse developments.



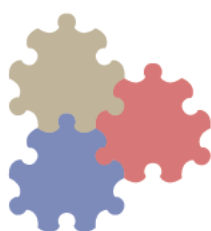
STEP.1



STEP.2



STEP.3



STEP.4



STEP.5

STEP.0 Set the task

First, the teacher sets a “question (task)” for the unit. At this stage, the teacher sets the task to be solved by combining what the children already know with three or four pieces of knowledge. The teacher prepares reading materials, which are necessary to solve the task, for each piece of knowledge.

STEP.1 Become conscious of what you know

Once the children have been given the “question”, they write down their answers individually based on the ideas that they have come up with by themselves.

STEP.2 Become an expert through the expert activities

Children form groups to read the same material, discuss the content and meaning of the material, and deepen their understanding within the group. This activity is called the “expert activity.” The children become a bit more knowledgeable about the materials they are responsible for.

STEP.3 Exchange and integrate through the jigsaw activity

In the next stage, a new group is assembled where each child in the group has read different materials, and each child explains what they understood in the expert activity they participated in earlier. In this group, since each child is the only one who knows the original material, the child will explain it in his or her own words conveying his or her thinking. This activity leads to other activities where the child reflects upon his or her own understanding prompting new questions. At the same time, the child listens to explanations on other materials from the other members and further deepens his or her understanding by considering the links between these materials and the material he or she has read. When deeper understanding has been achieved, the children integrate their knowledge of each part and create an answer to the question.

STEP.4 Present and find expressions in the cross-talk activity

Once the children have finalized their answers, the children present them to the class together with the reasons for their thinking. The children listen to the explanations given by others and re-express their answers in the form of a presentation to the whole class. Even though the answers which come from each group are the same, the explanations for the reasons for the answers will be slightly different. By examining individual answers and reasons, each child has the chance to examine his or her way of integrating the answers through the diversity in the answers, and reaches an explanation that he or she is satisfied with.

STEP.5 Go back to individual answers

The children once again look at the question which was set at the beginning, and again write answers by themselves at the end of the class.

The Knowledge Constructive Jigsaw method is one of the types of teaching practices in a classroom that elicit collaborative learning as recommended by CoREF. CoREF has been working on creating lessons using the Knowledge Constructive Jigsaw method in collaboration with the boards of education, schools and other organizations all over the country. On our website, you will be able to see typical examples from the 1,451 teaching plans and materials of elementary schools, lower secondary schools, and upper secondary schools developed thus far (as of March 2017).

Collaboration with the boards of education



At elementary schools and lower secondary schools

Collaborative projects with the municipal boards of education and school groups:

We support activities throughout the region and work on collaborative lesson teaching practices with the applicable departments for each subject across the municipalities using the existing networks.



Q: What is important when designing a lesson?

A: The first point is to present a lesson in a form where the child wants to think about the question which the teacher wants the child to answer. The second point is to divide the materials that the teacher wants the children to learn into pieces which when put together will form the answer. When the teacher makes the expert materials, the teachers should narrow down the contents to only the ones necessary to come up with the answer.



First-grade elementary school Japanese language class

Who ate it?

These are Japanese language teaching materials through which the children decipher who ate the tree nuts and leaves from "the traces of the leftovers." Children read about the shapes of the traces and the animals separately and bring the information together through which they develop an image of the "content" and "form" of the text. This "question" worked very well.

STEP.0 Set the task



Q: Why do the children have to be in different groups for the expert activities and jigsaw activities?

A: This is to enable each child to come up with their own new answer in the Jigsaw activity. By rearranging the groups in the middle of the lesson, activities commence where each child creates their own answer after they become convinced that "there is something I want to tell others in my own way", and "everyone's thinking is different."



First-grade lower secondary school science class

Why do we have four seasons in Japan?

Students confirmed the movement of the sun during the summer solstice, autumn equinox, winter solstice and spring equinox in the Arctic, Saitama prefecture (the location of the school), Singapore, and Adelaide (a town on the other side of the earth of Saitama), then brought the information on the four locations together, and discovered the relationship between the tilt of the axis and the seasonal changes. The photo taking functions of the tablet were used effectively.

STEP.1 Become cons

STEP.2 Become an e the expert ac

STEP.3 Exchange an through the j

STEP.4 Present and in the cross-t



Q: How should teachers behave in the classroom?

A: First of all, teachers should listen to the children's interactions and try predicting what they are thinking. If children ask "What are we supposed to do?" the teacher should present the questions again, and tell them, "I want you to create your answers by yourselves." In the cross-talk activity, it is sometimes useful to guide the children's attention to differences in their presentations.



Sixth-grade elementary school mathematics class

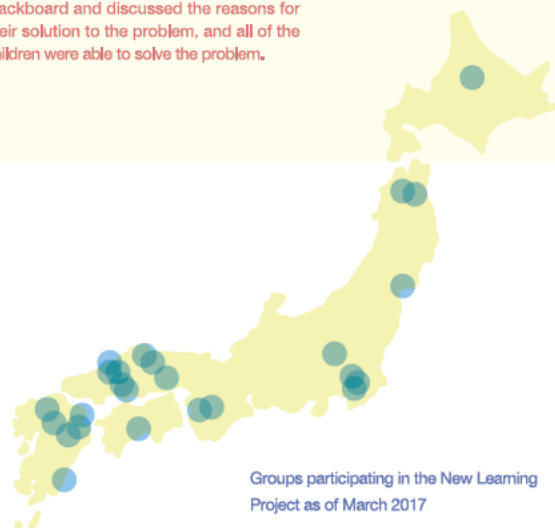
How many outcomes are possible?

The children find the number of possible combinations when choosing two flavors from six ice cream flavors. First of all, children think about the number of matches in four teams using a table, a polygon figure, and a tree diagram, and integrate them to solve the ice cream problem. In the cross talk, the children gathered in front of the blackboard and discussed the reasons for their solution to the problem, and all of the children were able to solve the problem.

STEP.5 Go back to in

Collaborating municipalities

As a "New Learning Project," CoREF has been conducting research collaboration to create lessons for collaborative learning with the municipalities and schools, etc. throughout the country from Hokkaido in the north to Kyushu in the south (in FY 2016, 25 groups from 16 prefectures participated). In addition to the "New Learning Project," we have been involved with various training programs and implementation of teacher training conducted by various boards of education and schools etc. throughout the country (conducted 154 training sessions in FY2016).



Groups participating in the New Learning Project as of March 2017



At an upper secondary school

Collaborative project with a prefectural board of education. With a focus on Saitama prefecture's project "Improving "learning" to open up the future project," we have been collaborating with Yamagata prefecture, Nagano prefecture, Tottori prefecture, and Oita prefecture amongst others. The sharing of information beyond the prefectures has also begun.

First-grade upper secondary school: Information and Society

Can it be said that the number of cases of theft in S City have increased dramatically?

There were 500 cases of theft in 2011 and 520 cases in 2012 in S city. Students decide whether a report that said there had been a dramatic increase is appropriate by combining three points of view - the characteristics of a bar graph, the characteristics of a line graph, and ways of thinking considering amounts through a comparison of percentages. The students had a deep discussion on the different aspects which appear when rationally analyzing reports using a graph which seemed correct on first sight.



Q: Why do you ask the same question again before and after the class?

A: This is so that the teacher will be able to ascertain the starting point of each child, and will be able to prepare for the next lesson by clarifying what and how much each child has learned. Another point is so that each child will be able to realize their own growth. About 80% of the children will answer close to the expected answer in many of the lessons.

conscious of what you know

expert through activities

and integrate jigsaw activity

find expressions talk activity

individual answers

First-grade upper secondary school agriculture class

Guess the name of the tree from the shape of the leaf

The students categorized the leaves of 10 different kinds of trees according to three criteria - leaf attachment and leaf quality, leaf margin shape and veins and overall leaf shape. When all the results were combined, the students were able to work out the names of the trees just by looking at the leaves. It took some time at first, but the name of the tree was gradually identified, and an important basis for the gardening course became long-lasting reliable knowledge.



Q: Can this method be used even if there are differences in academic ability or communication skills?

A: Yes. The key to the Jigsaw is that children with diverse ideas are able to refine the quality of their answers through interaction. So, in the expert activity, not all the children have to become experts as assumed by the teacher. There is no need for a leader.

First-grade upper secondary school geography and history class

Imagine you were caught in torrential rain near the NHK Center in Shibuya

Students think about how they would escape to Shibuya station or Meiji Jingumae station and why they would do so by combining three viewpoints - differences in the height of the land in neighboring areas, the course of Shibuya River (culvert) and past incidents of flooding in Shibuya ward. Opinions were divided, but all the groups suggested their own realistic solutions after confirming the safety of the topography of Shibuya.



Q: How do you assess the long-term effects of this form of lesson?

A: We assess the effects from these points of view - whether or not the children are able to remember their thinking during the classes and use this thinking in the next unit or in another class, whether new questions are generated by the children, whether there are fewer blank answers for questions asking for written answers, whether or not the children attempt to tell others what they want to say, and so on. We can assess whether their 21st century skills have developed.

Collaboration with Saitama Prefectural Board of Education

CoREF has been collaborating with Saitama Prefectural Board of Education since FY 2010 in terms of creating collaborative learning lessons. This project expanded to include 102 schools in FY2016. In addition to the 97 schools, which make up about 70% of the prefectural upper secondary schools, there are four municipal upper secondary schools and one prefectural lower secondary school. The range of continuous lesson improvement projects to foster the ability of children to live autonomously in the 21st century covers a wide area, including the training of core teachers, improving the teaching skills of novice teachers, and sharing the vision of the staff in managerial posts.

Toward new models of Connection among High school, University and Society

Do high school students have clear images of university?

High school students, undergraduates and graduates seek practical knowledge that can bring them into the future world.

Those who participate work together in a networked world.

A new type of upper secondary school-university collaboration

Isn't it the case that in science and social studies up to upper secondary school, there is only one answer to the question? People's intellect which undergoes a change from upper secondary school to university and from university to society is actually learning from doing where people refine themselves in an effort to find an answer even though there is no one fixed answer. If one attempts to give form to something which one knows logically in one's head, this cannot be done perfectly the first time round. Yet one answer leads to the next question, and generates the next world. First, you think using your own head, come up against other people's opinions, and then create something using your hands. Then, if you feel that you have discovered an inkling of a path leading to an answer, you should listen to the slightly different opinion of a different expert. Intellect can be refined through the sharing of questions so as to pose questions that do not yet exist.

This new form of collaboration between upper secondary schools and universities is an experience of learning through doing where upper secondary school students, university students, and graduate students all come together, and use their heads and hands to create an answer. There are so many situations where students have knowledge about "immunity" and "parachutes", etc., but do not know what to think when faced with specific tasks. It looks like students can reach out, but it is difficult to actually do. But when the students check the ideas that they think are good in the process of thinking, they are able to select, use and answer each other, which means the overall level of creation rises.



Network of networks

People belong to various networks such as families, the neighborhood, schools they went to, workplaces, future friends. The number of people they often socialize with are not that many when you consider each individual network. Our networks where we make teaching materials and revise our lessons together tend to be small networks made up of people whose company we feel comfortable in, or fun networks with a common purpose. There are networks where the members' occupations, thinking and places of residence may differ, but frequent emails are sent among the members. We try connecting or disconnecting such networks, closing and opening them, and expanding them all at once. We try out various relationships and interactions. In the era of MOOCs, we attempt to provide OER (Open Education Resources) meeting the needs of society.

Teachers' networks also change in various ways, depending on subject, school type, jigsaw method class formation. Children's learning networks also change when they leave from original group that several children reading the same material to other group which made up by children who responsible for other materials to create a new answer. If robots who have "prepared for the lesson" participate, they can show researchers how people learn in such a network. We are conscious of various forms of networks and make these networks stronger.



New assessments

Assessments open up an observation window which allows us to explore the cognitive process of what people are thinking at that moment which usually cannot be seen. From this, we are able to investigate how people become wiser. For this purpose, we assess the learning "process" by relying on changes in what people are saying in the process of their learning. We want to know the path not the point of arrival, the new goals that should be ahead of the point of arrival, and 21st century skills that enable us to reconfigure our goals and create a place for learning by ourselves. Now, society requires such an assessment of learning. As new assessments are born, the current schools change and teachers change. And it also should become easier for us to see how we can become wiser than before.

In situations of learning through interactions, each single utterance from a student becomes a window of observation which opened up. If all of the records of the interactions of every child in the class where the child considers whether his or her answer "really is the answer" were to be listed, the records would show that everyone seeks proof for their answer. All people, even elementary school children, like to create answers for themselves. They like to ask others to listen to their thinking. We intend to pursue a new form of assessment which will enable us to view the real essence of learning.





A new type of upper secondary school-university collaboration

Almost once a year we hold a symposium to think about learning through doing with collaboration among the upper secondary schools, universities and public administration. At the first symposium, university researchers and education heads discussed the possibilities of connecting upper secondary schools and universities “vertically, horizontally and diagonally” from their respective standpoints. In the future, we will be addressing such topics as the globalization of education, generation and utilization of OER, the creation of new jobs and research fields that should be at the center of upper secondary school-university collaboration.

At the University of Tokyo campus, we have been carrying out trial lectures where upper secondary school students, undergraduates and graduate students experience learning through doing together. Upper secondary school students, university students and graduate students form groups, solve tasks together, and discuss with young researchers “what they want to know next” which develop naturally from their experience. The first lecture was “Immunity and Health” while the second was “Slowly Descending Parachutes.” Undergraduates, graduate students and upper secondary school students also participated in the planning and management.

Collaboration with companies and a network of working professionals

Professionals and senior colleagues who have been developing new products at Japanese companies propose ideas that led to manufacturing in the form of the Knowledge Constructive Jigsaw method.

We will post the teaching materials that were developed by them on our network and send them in a form that can be used in elementary schools, lower secondary schools and upper secondary schools. We will also consider using them in flipped classrooms.

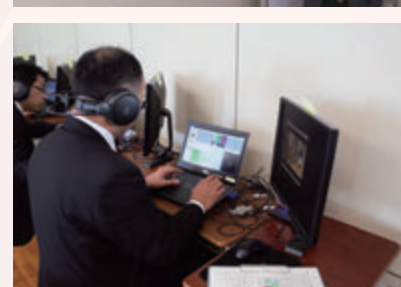
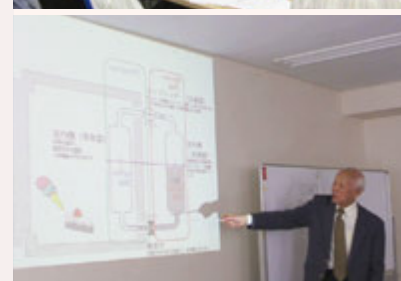
Endeavors of new educational support

We introduced remote control type robots which participate in the Knowledge Constructive Jigsaw class in the manner of “friends learning together,” and explored the design principle of a place where children can learn from interactions. When we let remote control type robots operated by the teacher participate in a lesson with a group of children, a new awareness about children’s learning developed among the teachers.

Trying out new assessments

Having one computer per child can also be used as a tool to take memos and record utterances made by the children during the class and to provide data to look back on later.

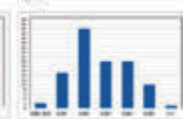
If all of the utterances and notes of the children of the class were to be recorded, it would be easier for the teachers to review the lessons and plan the next lesson. A new collaborative lesson design and a new classroom environment design enable a new assessment that is capable of analyzing the process of learning as it is, and supporting the development of the next lesson while also monitoring the actual situation of the children's learning.



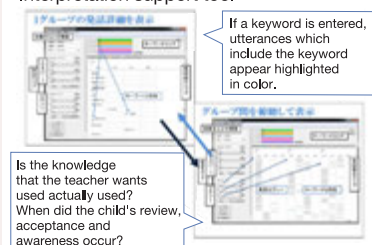
Pre-test



Post-test



Interpretation support tool



Future expansion

Forms of collaborative training

Half-day training

New learning principles introduced mainly through experiencing the Knowledge Constructive Jigsaw method as students.

One day training

New forms of learning introduced and experienced during the morning as students, and lesson making and assessments experienced in the afternoon as teachers.

Four-part training in one year

May : Understand the principles of the Knowledge Constructive Jigsaw method and try out two existing teaching materials as students.

June : Create an image of a lesson plan based on existing teaching materials and the experiences of senior teachers. Each participant tries teaching once after the training.

October : Compile the results of the teaching practices and examine the lesson design based on the learning records. Find a hypothesis for the creation of the next lesson. Teach again afterwards.

January : Examine the lesson design using the records of learning outcomes and processes.

Organize a lesson design hypothesis which was discovered from two cycles of lesson design, teaching and reflection.

Course on learning sciences and lesson planning led by the University of Tokyo

Once a year training

Members of the collaborative boards of education and schools, and other working professionals gather at the University of Tokyo and hold a workshop on the learning sciences and lesson planning. Going beyond school types and occupations, we review “the actual processes of children’s learning” so as to create lessons for the future.

Once a month training

Classroom teachers who have been recommended by the boards of education regularly gather at the University of Tokyo about once a month, and learn about the learning sciences to promote lesson planning. After returning to their schools and putting their knowledge to practice, they share and examine the results of the teaching practices. Started from small networks of teachers, it has been expanded to multiple large networks.

Creation of practical learning sciences in collaboration with the global learning sciences bases

We will be forming a new base for practical learning sciences which strengthen practical approaches in collaboration with the world’s leading research centers of the learning sciences such as LIFE Center at Stanford University, OISE at Toronto University, TELS at University of California Berkley, Hong Kong University, Singapore Nanyang University, and the Pearson Group.



CoREF portal site

<https://coref.u-tokyo.ac.jp/>

If you would like to know more about our activities, please visit the CoREF portal.

The CoREF portal provides various resources including “Collaborative Learning Resources”, that you can refer to when creating lessons based on the Knowledge Constructive Jigsaw method and “Today Resources”, which summarizes the contents of educational support provided by the University of Tokyo.

You can also read reports on past activities (the photograph is from the FY2013 edition), which summarize the outcomes of projects implemented in collaboration with CoREF and other organizations, including collaborative boards of education, and the “Lesson Design Handbook of Collaborative Learning” posted on the portal.



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