

# Highly Effective Learning with “VRschool”: Beyond 360-degree and 3D

**Tatefumi Kanaya**  
CEO, TEN UP Inc.



## 1. Current ICT education and VR education

Most people think of VR as a new technology, but actually, the concept of VR has been around for over 100 years and has been researched by many companies and research facilities. However, it began to attract more attention even from the business world in 2016, which is considered by some to be the birth year of VR. This was because in 2016, VR hardware and communications environments (Wi-Fi) had consolidated, and VR moved from a research level to a practical level.

Much research had already been done on VR, so our company, along with many others, quickly began creating services and commercializing them. However, before VR arrived, the education industry had not yet progressed developing ICT education using PCs and other technologies. Many opinions and reasons why ICT education had not advanced have been given, but we wanted to know the truth, so we got involved attempting to introduce ICT measures in management of our own tutoring school.

It was then we realized why introducing ICT at the classroom level would not succeed. We found that those working in the education industry were very aware and focused on issues such as educational ideals and how to interact with students. Thus, we began to feel there might be hesitancy toward the idea of using IT to improve efficiency in education.

As such, it would be difficult to expand ICT education from just the perspective of technologists, by replacing materials on paper or a blackboard using PCs or tablets in an attempt to improve efficiency. The perspective of instructors needs to be incorporated somehow, with their warmth and enthusiasm for education.

In other words, it is important to create environments using technology that will involve the instructors, so they can be more active than they have been before.

## 2. How does VR change the brain?

Prof. Jeremy Bailenson of Stanford University has written, “Experience on Demand: What Virtual Reality Is, How It Works, and What It Can Do?” Much interesting research has been reported about this as well, but he writes that education and training using VR can increase accuracy of understanding by up to 25%.

He also writes that when data on the posture of students receiving classes in VR space was analyzed, it was possible to

estimate the grades of each student, before they took a test.

Thus, there are many aspects of VR that we can look forward to.

Further, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) Research Cooperation Council (Science and Technology Policy), also has a study group for research on “Neuroscience and Education.”

It is also well known that when dopamine levels increase, ability to concentrate also increases.

VR is a technology that can affect the visual senses, and in humans, vision is the sense that brings the most information to the brain. In other words, VR is able to both affect the visual senses and to evoke higher levels of concentration.

Currently, various uses of VR are being considered, but the most common is for education and training, and we can expect it to bring major changes in the form of innovation in the education industry.

## 3. Does VR create new communities?

One promising use of VR besides education is for communities: so-called “social VR.” We can look forward to being able to communicate in virtual spaces, having conversations, holding events, and creating other new forms of communication. In fact, the University of Tokyo has already held classes using a social VR platform. The benefit of VR for education is that, although people are known to change with their environment or customs, it is difficult for people to make dramatic changes to their environment in daily life. With VR, it becomes easy for them to put themselves into any environment.

For example, one can work on communication with foreigners as you would when studying overseas in a VR environment with only foreigners and it is easier to become a professional in a field when in the community of that particular profession.

Another unique case of VR research is being done at the University of Barcelona, called, “Effects on cognitive function of embodiment through VR.” The research examined the effects of embodying Einstein, and found that participants achieved elevated scores on cognitive function tests.

It may seem strange that participants achieved higher scores just by impersonating Einstein, but when examining participants for whom the effect was particularly strong, they found that the effects were stronger among participants that showed lower self-esteem in their daily lives. In other words, when people with low

self-esteem, who were not manifesting their own abilities, took on the persona of Einstein, as a symbol of smart people, they seemed better able to demonstrate their own abilities.

#### 4. VRschool (School education case study)

So far, we have discussed technology that supports teachers doing more for students, to promote ICT education in the education industry. The assumption was that supporting the teachers is what is important. We touched on the potential of VR technology regarding its brain-science and community effects.

Here we discuss some background and examples from our company's VRschool initiative.

##### [Example 1: Elementary school, grade 5 (VR science class)]

- (1) Learn about compasses and the movement of the earth and sun in a VR classroom (Figure 1).
- (2) Move the VR space to a park (Figure 2).
- (3) Ask the question, "Which way is north?"

■ Figure 1



■ Figure 2



The teachers also join the class in VR space as an avatar, and gives the lesson, so their essential role is not lost, and the lesson can be more interesting than in an ordinary classroom. The students responded well, and the teachers were also able to utilize their strengths.

We now consider reactions to the lesson. Although part (1) was online, the children enjoyed it, and for the important parts

(2) and (3), the students were able to enjoy it like a quiz show, and were able to move around, looking for various hints in the VR garden, so it was more like a field trip.

The answer to the question (3) is that, they will find a clock if they look around in the garden, they can see that it is morning by looking at the clock, and guess that in the morning the sun should be in the east and that shadows would point toward the west. Solving such a riddle with the teacher creates a class that is "better than real" for the students.

This type of learning methodology is called active learning in the education industry. In ordinary learning, classes would be held for each unit separately, such as compasses or the movement of the sun, and students would understand them each in their heads, but it is difficult to increase students' ability to combine and apply them both together as was done here, when they derived the compass directions in an empty garden.

We have found that with VR classes, we can increase students' ability to apply knowledge, to formulate their own questions and hypotheses and to think about them.

##### [Example 2: Elementary school, grade six (VR class content for Japanese language)]

- (1) Lesson in a VR classroom on the haiku, "The old pond/A frog leaps in/Sound of the water." (Basho).
- (2) Move to various ponds in VR, watch scenes of frogs jumping into water (Figure 3).
- (3) Return to the VR classroom, and consider the meaning of a haiku.

■ Figure 3



As with Example 1, students were able to have an enjoyable class with guidance from the teacher. Incidentally, the Japanese-language haiku classes are generally thought to be very difficult to teach, and are not popular with the students.

In part (2) of this lesson, many of the students reacted, saying things like, "The frog jumped into the pond!" so the teacher can then say, "Okay, let's look at some scenes with frogs jumping in," and move to other locations. Various scenes with frogs jumping into the water were reproduced, such as a pond near a summer fireworks festival, another near a residential area, and another

quiet one with no one around. VR is well suited to reproducing various scenes in this way.

In this case, there were various reactions to experiencing scenes of frogs jumping into a pond, focusing on different aspects such as the frog, or the type of pond.

The haiku is “The old pond/A frog leaps in/Sound of the water,” so we focused on the water sound and experienced various pond scenes again. This showed that unless it was quiet, we could not hear the sound of the frog jumping into the pond. This made us realize that the “plop” sound of the frog jumping in is pretty quiet.

So what was Matsuo Basho saying with this haiku? This is where teachers would apply their classroom expertise. We will give an answer below, but in a class, the teacher would discuss with the students, convey important ways of thinking about it and help them improve their Japanese language abilities.

The frog was not important in what Basho was trying to say, but rather, a quietness that would enable one to hear the sound of the frog entering the water.

Discussing this in a VR classroom creates a lesson completely different than earlier haiku lessons, changing how students grasp it and conveying how interesting haiku can be.

### [Summary]

Example 1 emphasized the visual, while the lesson in Example 2 was designed with awareness of sound. Both lessons utilized features only possible with VR, and the teacher was able to hold lessons that attracted the students’ attention like never before.

Here, the most important feature of VR lessons is the ability to “convey.” In conventional lessons, teachers give proper lessons where it is important to “convey” the relevant ideas, and students listen to what the teacher says, imagine it in their own way and come to an understanding of the content. However, with VR, the same scene can be shared, with a 360-degree view, and what the teacher wants to convey can become clear at a glance.

## 5. VRschool lesson planning

We discussed two examples of VR lessons that we think show how they can be engaging. We will now discuss how lesson planning can be done for VR lessons.

Considering that lessons go from elementary school to university, there is a great range of content. Not all lessons can be planned to use the five senses as was done in the earlier examples.

Examples of when the five senses can be utilized easily include when ideas in science or math can be illustrated (visually) as in Example 1, or experienced bodily, as with a story in a language class. Another example would be reproducing (visually) an English conversation scenario.

On the other hand, there are topics in learning that cannot be visualized. While the arithmetic we learn in elementary school is often used in everyday life and can be visualized easily, more

abstract concepts arise such as negative numbers or square roots, which are not used often in daily life. It may be difficult to represent a square root in 360 degrees, so perhaps this concept is not suited to a VR lesson.

To review, the two effects provided by VR are “brain science” and “community”.

For a given topic, where learning is done is an important factor.

We conducted experiments examining the extent to which community affects learning outcomes.

### [Experiment 1: Solve a complex mathematics problem with math colleagues throughout the country]

- (1) Prepare a difficult mathematics problem in VR space.
  - (2) Gather mathematics enthusiasts from throughout the country and have them solve the problem together.
- \* Also perform the same using a Web meeting system.

### [Experiment 2: Students from regional high-schools consult university students in Tokyo about how to get into university]

- (1) Gather high-school students in VR space, together with students from the university in Tokyo where they hope to attend.
  - (2) Have the university students show the high students the school, club facilities, and living arrangements at the university.
- \* Also perform the same using a Web meeting system.

In both of these experiments, participants felt a deeper sense of connection with the community than they did when using the Web meeting system. A reason for this is that for Experiments 1 and 2 with the Web meeting system, the person speaking becomes the center of attention while the others feel like spectators. This occurs even for the person holding the Web meeting.

On the other hand, with VR, participants are in the same online space and feel like they are participating together. As such, community use is well suited to VR. One of the university students in Experiment 2 said that, “rather than showing photographs of my home, it felt more like they came to visit my home.”

## 6. Practical examples from outside the education industry

### [Example 1: Staff training at a construction company]

At a certain construction company, several site managers were expected to retire over the coming several years. Since the construction company revenues are determined by the number of sites, cultivating younger employees that are able to manage new sites had become an urgent task.

However, in construction, site managers are cultivated through experience on many sites, so educating new managers is not a simple task. As such, we used our VR school system for the following three tasks.

- (1) Have employees at sites throughout the country capture 360 degree photos of everyday issues and errors.
- (2) Use our system for online schooling of site-manager candidates.
- (3) Have candidates look at many examples of issues occurring on sites every day.

■ **Figure 4**



Through these activities, we were able to simulate many real on-site issues. Moreover, these simulations were not textbook experience, but actual accidents and incidents that occurred throughout the country at real sites, providing experience useful for practical work. Normally, employees can only experience work at a few sites per year, but by simulating site work using our system, they can gain experience from 100 sites or more. Participants have said they feel like they have gained 20 years worth of experience in a single year.

**[Example 2: Fan event hosted by a talent agency]**

Due to COVID-19, talent agencies could no longer hold fan events, so a major component of their business disappeared and the fans no longer had opportunities to meet the personalities. As such, we used our VR system to hold events where these personalities could make appearances as avatars.

In theory, fans can see these personalities with higher-quality video on television or YouTube using an app, but in a VR space, we can provide fans with a more satisfying feeling of being with them rather than just seeing them.

This example demonstrates the community effects of VR.

**7. VR in the future**

The technology singularity moves quickly. We have been expecting education and communication with VR to take a little longer, but it has become possible before we even realized it. Even communication capacity, which is an issue at this stage, can be expected to be resolved soon with technologies like 5G. When that happens, rather than the mainly just 360-degree images as we have now, we will finally be able to use a combination of 360 degree live and recorded video and multiple other images and video without difficulty. Then, beyond being able to have

interesting lessons with 360-degree and 3D materials, we will enter a world where we can immediately visit any community, in any country, whenever we like.

Returning to the issue described at the beginning of this article, ICT in the world of education has not yet captured the enthusiasm of instructors, but we believe that VR is a technology that can advance ICT, while leaving this enthusiasm intact.

Education is a relay, with human instructors passing on the baton of enthusiasm and person-to-person communication, which is a precious and essential thing.

While writing this article, we reviewed use of ICT in the education industry. Why is it that we say “ICT in education,” rather than “IT in education?”

IT: Information Technology

ICT: Information and Communication Technology

The answer is in the words themselves; that communication is very important.

We can enjoy lessons with 360-degree images and 3D, and have positive communication. Communication is really “social relations” and communication makes things happen.

ICT education has been a term used by education providers. Should they use paper learning materials or a tablet? Both are media that providers can use, and the students do not even use the word ICT. However, students will enter and enjoy a VR classroom on their own, and VR is a word that both the instructors and the students use.

It has long been said that ICT will not become widespread, but we believe that VR is a technology that can open it up.

*Cover Art*



**Maple Leaves at Tsutenkyo (Famous Places of Kyoto)**

Utagawa Hiroshige (1797~1858)

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