

# Application of E-learning System Reality in Kyoto-style Earthen Wall Training

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**Abstract.** In this paper, application of e-learning system in Kyoto-style earthen wall training was introduced and investigated. Simultaneously, a new design of e-learning (on-line) “Kyokabe” coating teaching system was put forward and established focusing on the analysis of motion, electromyography and eye movement. Consequently it was verified to provide a platform to publish the latest quantitative researches and coating technical skills for assisting beginners to understand the key points in process technique from expert.

**Keywords:** E-learning system, Kyoto-style earthen wall, clay wall, training, painting.

## 1 Introduction

In ancient times, timber and clay were played very important roles in the building materials of Japanese house. The timber was applied to reinforce frame structure and the filler wall was adopted with the clay. It could date back to as early as the Nara period, 1300 years ago or even earlier.

The culture of clay way has been deeply entrenched within Japanese people’s heart. With the development of building technology, high-strength reinforced concrete frame structure has been extensive application in modern Japanese architecture, which replaces the most of Japanese traditional clay wall. However, clay wall was made of natural materials. The features of moisture conditioning properties and absorption properties of indoor pollutants were one of the most excellent performances that cannot be replaced.

Out of respect for traditional culture and considering the advantage of natural material, more and more Japanese people are willing to choose the clay wall to decorate their interior and exterior wall nowadays. Among them, a kind of clay wall called “Kyokabe” was produced in Kyoto, which is famous for thin but strong and able

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to send out a fragrant smell. “Kyokabe” production is a very complex process and divided into three coating layers. A skilled craftsman has to spend a substantial amount of time and effort to make an excellent “Kyokabe” with a strong wall and beautiful patterns. Additionally, it is very difficult to teach key points for coating technique to beginners by oral transmission and action demonstration. “Kyokabe” beginners have to take about ten years, or twenty years of deliberate practice to become an expert. In the past, beginners were accepted coating training after junior high school. Due to the higher requirements on basic education modern society, most young people starts to coating training after graduating from high school or college, who will become a full-fledged craftsman of “Kyokabe” after 30 years of age. Therefore, it is urgent time to pay attention to reduce time of training cycle and keep healthy development of this traditional industry.

Kyoto Sakan Vocational-technical College is one of the most elite “Kyokabe” training school in the Japan, which always has been seeking a useful and available way to transform these experts’ tacit knowledge to explicit knowledge in order to shorten cultivating time and improve the efficiency of training. For this purpose, Kyoto Sakan Vocational-technical College’s researchers successfully applied ergonomics techniques and human factors engineering to find key points of “Kyokabe” coating. In past research, motion analysis technology, Electromyography technology (EMG), eye movement technology were carried out to analyze possible differentiation between expert and non-expert. It is unrealistic and high cost to measure the characteristics of each student’s operation with test equipment. This requires researchers to use results of related studies to design a standardized training plan.

In this study, a new design of e-learning (on-line) “Kyokabe” coating teaching system was put forward and established. It can provide a platform to publish the latest quantitative researches and coating technical skills and assist beginners to understand the key points from expert. In the system, the application method of trowel (an main tool for coating) was illustrated in detail by a short and clear video at firstly, which came from the thoughts and experience conclusion from expert. Next, the elements of each engineering process was introduced and summarized, and basic principles and attention points were emphasized as the same time. After that, the most important part was shown that what kind of essentials caused difference for technology during the whole production process between expert and non-expert according to the latest research of human engineering. Finally, each process was comprehensively reviewed and summarized. In this way, by using this e-learning system, the implicit technique from expert craftsman was well taught to beginners, and they can understand and accept it well too.

The target of this research was found a best way to develop “Kyokabe” teaching through set up an e-learning system based on the research achievements of ergonomics. In order to help “Kyokabe” coating beginners are able to become a qualified craftsman in a shorter time.

## 2 The Present Situation and the Development of Kyoto-style Earthen Wall Training

### 2.1 The Problems in the Kyoto-style Earthen Wall Training Industry

Kyoto-style earthen is a most outstanding representative of Japanese clay wall as called “Kyokabe”, which is especially famous for thin but strong and able to send out a fragrant smell. “Kyokabe” production is a very complicated process, which is divided into three coating layers as lower level, middle level and upper level. The lower level must have sufficient strength to counterbalance the whole thin wall, and the upper level is used to decorate wall. The middle level are combined the lower level and upper level, which are required to ensure strength and have a smooth surface so that facilitate to decorate the upper level. Fig.1 was illustrated a craftsman was making the “Kyokabe.”



**Fig. 1.** Kyoto-style earthen wall process

Generally, beginners can obtain system training of the production method and the design essentials of each layer. However, the best learner still takes more than ten years practice to become an excellent craftsman in order to master some imperceptible

and indispensable behavioral essentials, which is a tacit knowledge and highly dependent on intuition and experience.

On one hand, Japan is a highly developed country, the urban construction has been completed nearly half a century. Some craftsmen began to make the clay wall as a sideline, who was originally engaged in earthen wall. On the other hand, more capital was spent on national education as economic development proceeds. The college degree and bachelor's degree were used as benchmarks of the finance system of compulsory education to the extent that most young people starts to coating training after graduating from high school or college, who will become a full-fledged craftsman of "Kyokabe" after 30 years of age. It is difficult for them to start work and have their own families at the right time.

The Kyoto-style earthen wall training colleges have to face the pressure on the source of students these two reasons. Therefore, how to shorten the training time is the primary focus of the Kyoto-style earthen wall training industry.

## 2.2 Quantifiable Research on the Kyoto-style Earthen Technique

In this study, Kyoto Sakan Vocational-technical College was concerned, which is the first earthen wall college that applied ergonomics techniques and human factors engineering led into find key points of "Kyokabe" coating successfully.

**Table 1.** Process technique difference summary between expert and non-expert

	Expert	Non-expert
Movement	<p>Straight shoulder</p> <p>Keep upper limb and knees in the span width of both legs</p> <p>Trowel's movement located in the range of shoulder width</p>	<p>Sloping shoulder</p> <p>Left shoulder placed outside of both legs' span width</p> <p>Trowel moved from inside shoulder width to outside</p>
Muscle activity	Applied nessisary minimum limit of muscle activity	Larger power than the nessisary limit was employed
Eye movement	Slight is oftern gazed before moved trowel	Slight is often shifted in forward/backward and upper/bottom directions of moved trowel

In past research, three skilled craftsmens of Kyoto-style earthen, experience between 38 years and 43 years, were employed as experts. And eleven students from 3 month to 6 years were selected as non-experts. Motion analysis technology, Electromyography technology (EMG) and eye movement technology were carried out to analyze possible differentiation between expert and non-expert. The process technique difference was compared and showed in Table 1.

### 2.3 The Development Direction of the Kyoto-style Earthen Wall Training

At this stage, it is a very effective way to help students to realize their insufficiencies of key techniques by applying ergonomics technology. However, the spread and development of this method is also hindered to some extent by expensive cost of equipment and low accuracy of prototype part.

It is unrealistic and high cost to measure the characteristics of every student's operation with test equipment. This requires researchers to use results of related studies to design a standardized training plan.

Therefore, how to develop an efficient, low-cost way to popularize research achievement into teaching process based on transform these experts' tacit knowledge to explicit knowledge is a future development of the Kyoto-style earthen wall training.

## 3 The Realization of E-learning System in Kyoto-style Earthen Wall Training

### 3.1 The Establishment of E-learning System

As shown in Fig.2, the E-learning system is consisted of two parts to meet the needs of different periods in study process, and each display fifteen minutes.

In the first trial, the gripping and moving methods of trowel and the processing flow chart was explained in detail. The key point of each step was emphasized to give a first impression to beginners intuitively. Then, the performance's difference between expert and non-expert were presented by the three dimensional motion animation from various angles in order to strengthen their learning effect and promote the students understand and solidify learning point.

In the second trial, the main detailed points of painting technique have been elucidated through comparing the muscular activity and eye movement's difference between expert and non-expert. Learners can get a good knowledge of earthen wall technique and skill basically after former two trial studies.

### 3.2 The Usage Method of E-learning System

Basically, e-learning materials can be utilized and read by users' computer, smart phone and the other mobile terminal devices in order to meet social need of using diversity. However, if some parts of e-learning materials only limited in computer utilization we cannot access and read the related content by other devices option. Most importantly, no matter where they are, the learners are able to utilize e-learning system anytime if they bringing the mobile terminal devices.

### 3.3 The Characteristic of E-learning System

**Systematization.** Until the current stage, the learners mainly study the painting technique of earthen wall from craftsmen depend on observation and imitation. However, learners have to observe this painting process from the reverse side and profile because the craftsmen paint the wall facing the subject location. Furthermore, some minor muscle activity and eye observation method also are inconspicuous and significant technology.

E-learning course is consisted of two parts, and each display fifteen minutes

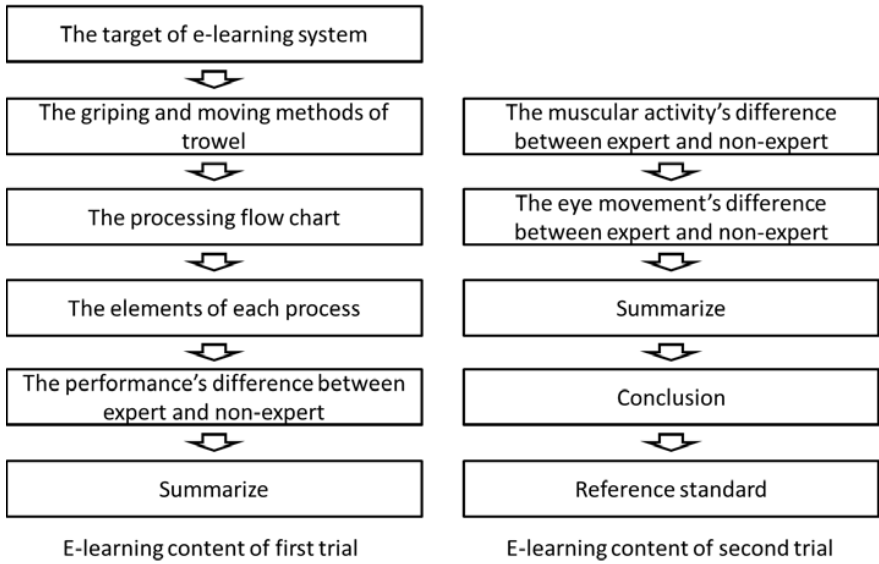


Fig. 2. E-learning system framework content

As shown in Fig.3, the instruction of the trowel, basic performed movement, the technique of muscular activity and eye's gazing track were passed forward to learners step by step. The most professional craftsmen were also employed to explain the key point of each step and share their technical essentials and experience with learners.

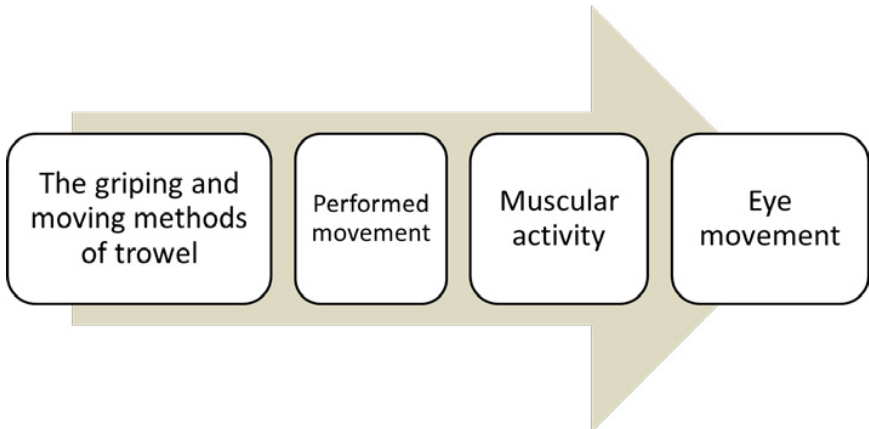


Fig. 3. E-learning material teaching flowchart

**Flexibility.** The E-learning system was divided into two parts. The first part have six chapters, and the second part have five chapters. Learning content can be freely chosen to view by learners based on the actual learning schedule. E-learning allow people to break through time and space to communicate study insight and obtain guidance from professional masters anytime and anywhere.

## 4 Conclusions

As well known, traditional skill and technique inherit realization was often investigated by “watching” approach. However, in fact, the opportunity of watching expert’s real process technique is very limited due to decreased related job amount in current social period. Therefore, it is urgent and valuable to establish the effective e-learning system for all learners.

In this paper, application of e-learning system reality in Kyoto-style earthen wall training was introduced and explained. It is deserved to find that learners are able to utilize e-learning system anywhere anytime to watch expert process technique repeatedly for mastering and getting a good knowledge of specialized technique and skill finally.

In a word, established e-learning system can support beginner’s learning effectively and also contribute to forwarding the latest study progress popularly.

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