研究ノート

Development and evaluation of the distance learning visualized(movie) simulation system for Radiologic Technologist

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❁ Abstract ❁

After Web 2.0 spread over the world, information society has been changing. Before people bought software, but now they can use software on Web. Then generally a distance learning system for Radiologic Technologist[1)] is expensive, however, the system we developed by Excel is not only inexpensive but also easy to make for non computer specialist (for example electrician). We can develop the system easily for a short time. From now we call a distance learning system for Radiologic Technologist as the system. Before, systems developed by Excel didn't have the axis of time[2)]. Actually a man who graduated from a science university developed one system for about 15 minutes. The main feature of our system is to have the axis of time and to develop the system quickly and easily. For example it is the system about an electric circuit (RLC), half a radioactivity and so on. We also developed the system about parabolic partial differential equations, but we treat ordinary differential equations here (for example $L\frac{d^2I}{dt^2}+R\frac{dI}{dt}+\frac{1}{C}I=0,\ \frac{dN}{dt}=-\lambda N$). In this paper, according to the statistical research to college students for Radiologic Technologist, we can conclude that our system keeps learning effect for a kind of students. Concretely the students are not good at a computer and Physics.

Keywords：e-learning, distance learning, simulation, visual, movie, radiologic technologist, web, wbt, excel

1. Introduction

The diagnosis and treatment radiology department set up in the university and the special school, and the one's first concern will say about how many people to pass the examination of the person of the own country with the manager, study side, and the student as being in so-called the national examination passing rate and not be exaggeration now. Passing might be the one as the WBT study support system for the diagnosis and treatment radiation engineer training this now to control the number of students of the university and special school as a management side, connects directly with finding employment, control the life consequently on the other hand for the student, and be a natural result.

Each university and the special school consider various measures. However, on the teacher side of each university and the special school, it is to the utmost in Fig.1-1 because it guides it. the professor the shown

various special subjects. Moreever, the difficulty of the national examination becomes difficult, it depends from a basic subject on attention, the special subject and the reinforced emphasis subject shift, and the way of every year has been updated. In addition, it is a current state that the scholastic attainments decrease it is not the same but especially recently becomes a problem, and the scholastic attainments decrease in mathematics and a physical subject is remarkable at the level of the student who enters a school.

One that WBT study support system for diagnosis and treatment radiation engineer training has been examined as the measures based on such a background[1]. These systems are machine that only turns over the page WBT, and it is the above-mentioned physical and is not mathematical, especially the explanation of the transients of, electricity, and however, it is not at all, and explains neither time series physics nor the electrical phenomenon even though it explains enough the sight.

Then, authors judged that they found the improvement that had to pay attention here, and suggested comprehensible system development for the student. Moreover, the incidental value to be able to develop various system and teaching materials such as the physical therapists and occupational therapist established as an annex as a relation research based on these technique styles was found.

Radiochemistry
Diagnosis and treatment image equipment study
Equipment study
Diagnosis and treatment image inspection study
Nuclear medicine
Technology study of nuclear medicine inspection
Technology study of radiation therapy
Medical image information study
Image engineering
Basic medicine outline
Radiobiology
Radiation physics
Medical engineering
Radiation measurement study
Technology study of X-ray taking a picture
Radiation safety management study

Figure 1-1

Thus, it was necessary to acquire the programming language such as visual basic VBA to have first of all to be deep to correspond, to study mathematics and physics, and to make these a programming in addition so far when the mathematical principle physics was studied.

Being forced is a reality as for loads of a great amount of time and the labor, etc. by the attainment. The learner the level of some mathematics and physics the learner this might cause the testee who throws it out to show up before it reaches the understanding of original mathematical principle physics. To study original mathematical principle physics easily in the meaning that prevented this, the partial differential equation simple numerical analysis study support system (Hereafter, it was called a system) was developed, and then, authors took, and analyzed the evaluation.

When the feature of this thesis is clarified, it becomes the following.

(1) The system of a possible numerical analysis of ubiquitous/mobile study environment that was able to be studied handily without using expensive numerical analysis software that was so far anytime and anywhere was developed.

(2) The above-mentioned system is a system in the learner according to making to visible that brings understanding forward as for the mathematical principle type of the partial differential equation etc.

(3) It applied to the testee (learner) by using the system and the effectiveness to understanding was confirmed.

2. System that developed

2.1 Basic concept of system design

1. The testee is assuming not a special environment but the environment that comes into normal person's hand very much to a basic feature and the concept of the system that develops.

2. It is possible to see as animation in the meaning that brings the understanding of the behavior of a mathematical solution and the testee forward.

3. As phenomenon of the mathematical principle physics. visually as possible, the testee can acquire from experience, and the original testee in the mathematical principle physics that should be studied is a system according to the study of a minimum programming technology and mathematics that can be squeezed as for the target. The design of the above-mentioned was assumed to be a basic concept.

2.2 Outline of system function

(1) Composition of method of system

Fig.2-1 shows the composition of the method of the system.[3]

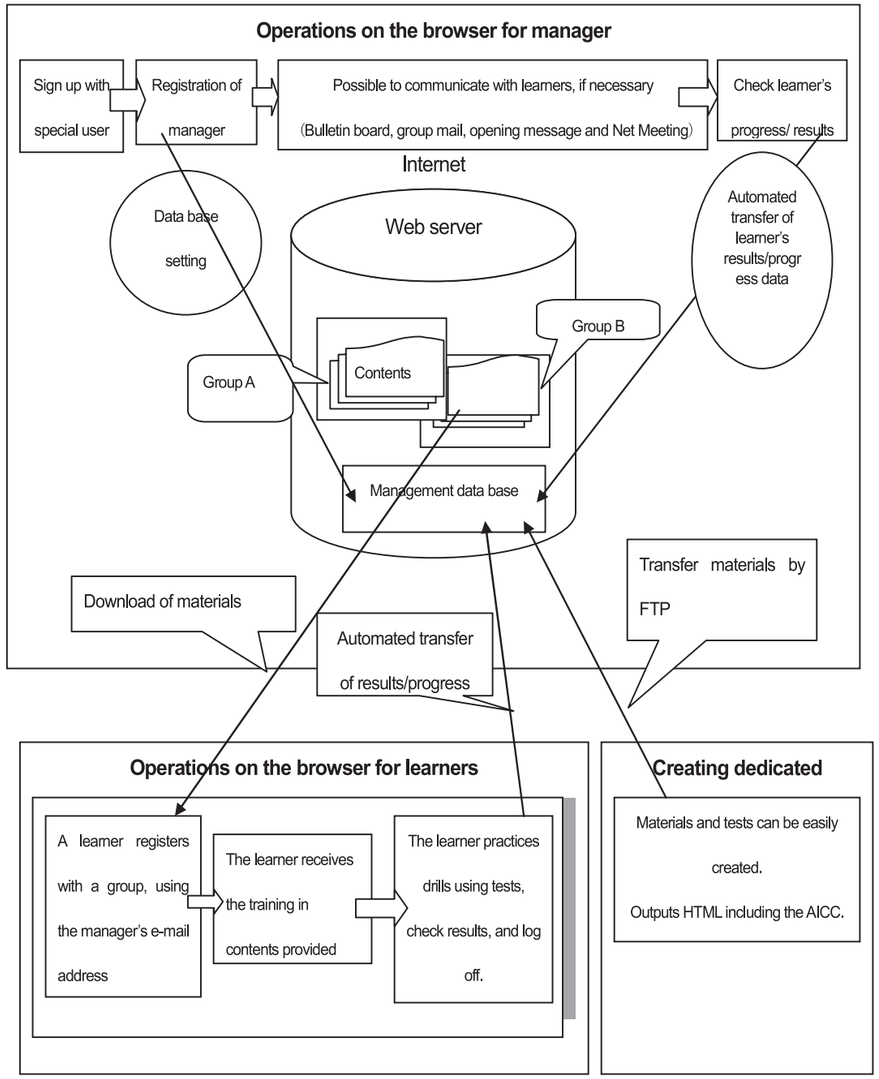

Figure 2-1

3. Effectiveness of learning support

Effectiveness of learning support was considered based on mini-tests done before/after lecturers given in the traditional way or e-learning on the website, and questionnaires. First, we have randomly-divided two groups A and B answer the past test of national examination Fig.1-1. Then, group A was given explanations in the traditional lecture way and answered another past test. Those in group B viewed the explanations on the web using the system developed, then answered the same past test as group A to evaluate its effectiveness. In addition, the following evaluation questionnaire was given to complete[4]. The questionnaire included 32 questions to be answered with 5-point (choice) scale. An example of this is shown below (Fig. 3-1).

Figure 3-1

3.1 Evaluation

3.1.1 Factor analysis

Three factors of "Mobilization," "Visualization," and "Lecturer ability" were detected by the factor analysis (principal component analysis and Varimax rotation) and Table 1 below shows subjective assessment items, factor loading, and factor name.

Table 1 (Factor analysis)

Component matrix

	Factor		
	Mobilization	Visualization	Lecturer ability
Studying in a mobile phone environment	0.836	-0.103	3.68E-02
Studying on the web	0.813	0.22	0.141
Explanations of background of electric engineering	0.733	0.209	-3.59E-02
Animated image that shows course of time	0.659	0.319	3.08E-02
Can understand more quickly by visualization than by mathematic formulas	0.105	0.916	4.70E-02
Visualization is better than mathematic formulas	0.115	0.867	2.80E-02
Interest in lectures	0.312	0.246	0.771
Whether you feel that it is too logical or not	-0.138	-0.138	0.747
Explanations given by lecturer	0.325	0.366	0.624

Method of factor extraction: principal component analysis　Rotation: Varimax method without a normalization of Kaizer

3.1.2 Discriminant analysis

It is predicted that factors which affect visualization are mobilization, visualization, and lecturer ability, however this cannot be determined only with a 3D scatter diagram (which is not provided here, though). Therefore, a different method will be considered.

When performing discriminant analysis in regard to before and after watching visualized images in Table 2, Wilks' lambda was 0.05 with significance probability of 0.034. Thus, it is clear to tell that learners were stiffly divided into two groups. We can conclude that there is a difference between before and after watching visualized images. Table 3 shows the results of T-test of two groups excluding learners who correctly answered more than half of questions from the beginning. With the significance probability of 0.17, it can be thought that simulation has some effects on learners who study electric engineering for the first time.

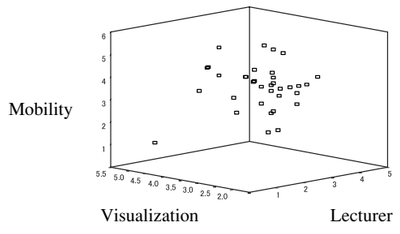

Figure 3-2

Table 2 (Discriminat between before and after watching visualized images)

Wilks のﾗﾑﾀﾞ

関数の検定	Wilks のﾗﾑﾀﾞ	ｶｲ2乗	自由度	有意確率
1	.050	48.091	32	.034

Table 3 (Discriminant between means of before and after watching the images)

対応ｻﾝﾌﾟﾙの検定

	対応ｻﾝﾌﾟﾙの差					t 値	自由度	有意確率 (両側)
	平均値	標準偏差	平均値の標準誤差	差の 95% 信頼区間 下限	差の 95% 信頼区間 上限			
ﾍｱ 1 差1－差	.42	.996	.288	-.22	1.05	1.449	11	.175

4. How the Learning Support System works

An example of the simplest learning support system which were used for this research will be shown below. The same procedures can be used for other topics as well.

RC series circuit (Explanations) RC series circuit saves electrical charge in a capacitor, but it will be filled to capacity someday in the future and then electric current will stop flowing. This can be shown as the graph of Fig. 4-1.

Before, systems developed by Excel didn't have the axis of time. The main feature of our learning support system is to have the axis of time and to develop the system quickly and easily.

Concretely by only using a macro of Excel we can develop the system by “for-next”.

Moreover we consider a curriculum Fig. 4-3 in the university.

From this curriculum, we conclude that after learning physics students should learn this system.

	grade	compulsory	choice
Physics	1	2	
Mathematics	1	2	
computer Ⅰ	1	1	
computer Ⅱ	1・2		1
Radiologic Physics Ⅰ	2	1	
Radiologic Physics Ⅱ	3	1	
Exercise of Radiologic Physics	3・4		1

Figure 4-3

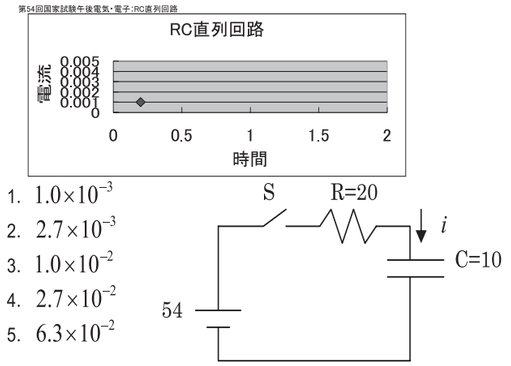

Figure 4-1

(Answer)　Initial value of electricity is $I_0 = \frac{V}{R} = \frac{54}{20000} = 2.7 \times 10^{-3}$ A. After this, electric current stops flowing as time passes. Therefore, the answer is 1 of 1.0×10^{-3}.

We also used parabolic partial differential equation to show how to create the system. (Fig. 4-2)

This is clearly easier than following program by C-language.

```
/* PDEGauss-Seidel method */
#include <stdio.h>
#include <math.h>
main()
{
        int N,i,j,c=0,max=1000;
        double
T[100][100],TK[100][100],E=0.0125;
        i=0;
        j=0;
        printf("分割数(1<N<100)N=");
        scanf("%d",&N);
        for(i=0;i<N;i++){
        /* 初期値 */
                for(j=0;j<N;j++){
                        T[i][j]=0;
                }
        }
        for(j=0;j<N;j++){
        /* 境界値 */
```

```
        T[N-1][j]=1;
        }
        do{
        c=c+1;
        for(i=1;i<N-1;i++){
                for(j=1;j<N-1;j++){
                TK[i][j]=T[i][j];
T[i][j]=(1.0/4.0)*(T[i+1][j]+T[i-1][j]+T[i][j+1]+T[i][j-
1]);
                }
        }
        if(c>max){
        printf("解なし");
        break;
        }
        }while(abs(T[i][j]-TK[i][j])>E);
        for(i=0;i<N;i++){
                for(j=1;j<N;j++);{
                printf("%f",T[i][j]);
                        }
        }
                printf("回数=%d",c);
}
```

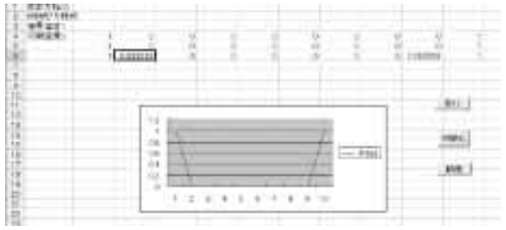

Figure 4-2

5. Conclusion

This research concluded that even simulation content with this degree of simplicity was effective for students who are not good at subject areas such as electric engineering which is tested in the national examination of radiological technologist and physical engineering including radiation. It took about 4 hours to create one simulation content, however, when you get into it, it would shorten the time of creating contents. Therefore, it can be expected that this can be applied to the test for radiological technologist as well as other subjects, or questions about different areas of study. Another good point is that it enables learners to study anytime anywhere in an efficient manner and allows educators to relatively easily create contents without expensive software. In fact, authors created animated contents of partial differential equation which appears in mathematical physics for science and technology students and had good results. For details, please refer to http://www.manabu.ne.jp/ju/ in which Schroedinger equation / Navier-Stokes equation[5] and Black-Scholes equation are covered for mathematical physics and for financial engineering respectively.

It is difficult to use software such as MATHEMATICA and Maple because it is expensive and there are also license problems in Web learning. Whereas the learning support system which has been developed in this research makes it possible to build a system easily and at low cost, and can offer greater flexibility in many different directions to system construction.

However, looking at the results of factor analysis of answers provided in the questionnaires, mobilization is greatly expected. Thus, creating a system which allows learners to study through mobile phone as well as laptop computer would be something that meets their expectations. Furthermore, they also have expectations for visualization, so it is necessary to create animated contents which are easier to view. As for lectures with a projector etc, it was revealed that it would be better to ask students to complete the questionnaire prior to a lecture of certain area, and then give a lecture to those who are not good at the respective area and teach those who are good at separately.

Developing a learning environment where mobile phone can be used is an issue for the future.

[Notes]

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