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# **I-Designer: a Computer-Assisted System for Conducting Information Technology Applied Instructions**

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## **Abstract**

*The growing popularity of computers and networks has attracted researchers to study strategies and the effects of information technology applied instructions. Previous researches not only demonstrated the benefits of applying information technologies to learning process, but also revealed the difficulty of applying them. One of the major difficulties is owing to the lack of an easy-to-follow procedure for the inexperienced teachers to design subject contents with proper use of suitable information technologies. In this paper, a systematical model for conducting information technology applied instructions is proposed. The novel approach can assist the teachers in designing information technology applied course contents based on the features of subject materials and the learning status of the students. An experiment on the Nature Science course of a junior high school has been conducted to evaluate the performance of our novel approach. Experimental results showed that the approach is able to associate subject materials with proper information technologies and hence the students benefited greatly by the constructed learning process.*

**Keywords:** E-learning, Information Technology Applied Instruction, Computer-assisted Learning, Science Education

## **1. Introduction**

Education is reciprocal affected with the change of the environment and evolves along with events occurring within the human society. All of the changes and transformations experienced by today's society have led to the restructuring and modernization of education systems (Castro et al. 2001). Educators are continuously challenged to find better tutoring strategies to improve learning performance of students.

In recent years, education has moved from teacher-centered learning to student-centered learning (Norman and Spohrer 1996). Objectivism is a teacher-centered learning method whose goal is to represent and transfer objective realities from the instructors to the learners. Instructors control the pace of learning and determine what knowledge should be presented or delivered to the learners. In an objectivist environment, the learners become passive recipients

of instruction, acquiring and assimilating common understanding from instructors or experts, rather than creating their own knowledge. Web-based environments that support the objectivist learning method are mainly used to deliver learning material without enabling any interaction with the material or with other learners (Khalifa and Lam 2002).

In contrast with objectivism, the existence of a common external reality is denied in constructivism, which stipulates that each individual can explore and produce unique concepts based on their experience and biases. Constructivism is learner-centered, meaning that the role of the instructor is to assist the learners in constructing their own knowledge. Proponents of constructivism criticize the objectivism method on the grounds that it transmits knowledge to students with little concern for whether the students understand or assimilate the material into their cognitive schema (Leidner and Fuller 1997). Web-based environments that support the constructivist learning method encourage free exploration of the learning material and enable a greater level of interactivity (Khalifa and Lam 2002).

With the advent of computer and information technologies, systems and learning theories have been developed for web-based learning in higher education (Fabos and Young 1999; Sun and Chou 1996), while the effectiveness of those implements have been empirically evaluated as well (Barrett and Lally 1999; Fabos and Young 1999). New technologies are present each day in more activities and, of course, in education. This great innovation is changing the concept of information technology applied instruction, not only in the teaching process itself but also the methodology applied. The new information age has changed the educational system, with the result being the birth of information technology applied instruction and computer-assisted learning (Castro et al. 2001).

Researchers have demonstrated how web-based teaching, distance learning, electronic books, and interactive learning environments can play significant roles in teaching and learning processes (Casini et al. 2003). They also showed various applications of Web technologies to the creation of different types of learning environments with different effectiveness. Although some Web sites are merely delivering traditional learning material (e.g., Word documents, PowerPoint presentations), others are taking a better advantage of hypertext and collaborative technologies (Khalifa and Lam 2002).

Researchers have suggested the teachers who try to apply information technologies to their classes to examine the instructional strategies supported by various environments so as to determine the relative effectiveness of these environments. One of the major difficulties of information technology applied instructions is the lack of an easy-to-follow procedure for those inexperienced teachers to design subject contents such that suitable information technologies can be properly applied to the tutoring process. To cope with this problem, a systematical model is proposed to assist teachers to apply proper information technologies to the development of tutoring strategies and learning activities. An experiment on the National Science course of a junior high school was conducted to evaluate the performance of the novel approach. Experimental results showed that the developed tutoring strategies and contents can significantly improve the learning performance of students, and hence we conclude that the novel approach is desirable.

## **2. Relevant Researches**

Network-based learning can be divided into at least two categories: the asynchronous type and the synchronous type (Khalifa and Lam 2002). In an asynchronous environment, learners can post their opinions about the topic being collaboratively explored and communicate with one another and solve problems at different times. Researchers have addressed the advantage of such an environment, including freedom from the constraints of time, space, and members, so

that the members have sufficient time to reflect on the topic and refine the expression of their thoughts (Wolcott and Robertson 1997). In a synchronous learning environment, members in a group learn collaboratively at the same time, which is closer to real-life collaborative situations in terms of social interaction, and the learning process for each member is more easily observed (Chan and Chou 1997; Jehng 1997).

The rapid progress in information technology can help instructors to teach more efficiently and effectively by employing new tutoring strategies with appropriate software tools and environments (Holmes 1999). Several studies have demonstrated the benefits of applying information technologies to instructions, such as Computer scaffolding (Guzdial et al. 1996), CSCL (Computer-Supported Collaborative Learning) (Harasim 1999), CSILE (Computer-Supported Intentional Learning Environments) (Scardamalia et al. 1989), CiC (Computer-Integrated Classroom) (Eshet et al. 2000), computer-based educational environments, etc.

In order to assist the instructor in teaching students how to use these electronic instruments through the Internet, many computer-assisted instruction systems have been developed (Huang and Lu 2003); moreover, with the popularity of computer networks, considerable attention over the last decade. With the first Web browser introduced in 1993, an estimated 20 million Web sites established by the year 2000, and current connectivity of PCs increased by 45 million in the first quarter of 1998, it is clear that the Internet has become a great resource for digitalized courses (Starr 1997).

The benefits of using Adaptive CAI systems make them desirable educational tools. It has been shown that greater efficiency can be achieved by basing the system development on the theoretical background of cognitive knowledge acquisition (Davidovic et al. 2003). One kind of CAI system can be thought of as a tutorial system, which is a guided system to provide well-constructed information. Students can use such a system to learn how to use a technical system or how to operate an instrument. In 1996, researchers presented a process for constructing a hypertext system (Susan and William 1996). In the same year, computer-based tutorials and virtual classrooms were used to teach circuit analysis (Burks 1996). Meanwhile, a tutorial system using artificial intelligence technology was proposed (Gang et al. 1996). Moreover, some researchers utilized auxiliary software to enhance their tutorial systems (Robert 1996), while some provided interactive tutorials for manuals with graphical user interface (Sally 1996) or with rich multimedia formats (Andrew and Steve 1996; Pui and William 1996).

In addition to its obvious use in a distance-learning scenario, CAL can also be used to enrich the classroom experience through the use of a data projector (Ringwood and Galvin 2002). For example, researchers have demonstrated a web-based remote laboratory for control (Exel et al. 2000). They also showed how remote experiments could be conducted via the Internet (Junge and Schmid 2000). There have been several well-known software environments developed to support remote experiments, such as LabVIEW (Ramakrishnan et al. 2000) or MATLAB/Simulink (Apkarian and Dawer 2000).

In (Dixon et al. 2001), a survey of the existing hardware and software tools that can be used in undergraduate control labs was reported. The need for uniformity and the standardization of the hardware and software equipment is pointed out. An Internet control lab solution, based on the MATLAB real-time capabilities running under Linux, is also described.

Educators have witnessed lately a proliferation of Web-based learning applications. These Web-learning environments have made learning much more convenient by stretching the

spatial and temporal barriers. Their effectiveness, however, remains to be examined (Khalifa and Lam 2002).

Considerable work has been done on the use of the Internet as a distance-learning tool, especially the discussions and surveys concerning web-based educational systems and their applications (Apkarian and Dawer 2000; Foss et al. 2000; Shor 2000) and the use of web-based simulation tools for education (Heck et al. 2000; Sreenivasan et al. 2000). In (Casini et al. 2003) and (Poindexter and Heck 1999), the usage of web-based educational systems in the control area were reported.

Although many information technologies are applicable to the instructional process, it is difficult for inexperienced teachers to select and apply proper technologies to the tutoring process. Consequently, in the following sections, a systematical model is proposed to cope with this problem.

### 3. Systematical Model for Conducting Information Technology Applied Instructions

Table 1 depicts seven candidate information technologies that might be applied to mathematics course instructions. In conducting the arrangement of information technology applied instruction, the possible number of difficulty levels for a subject unit, as well as that of the learning levels for a student, is 3, 5 or 7. For example, in Table 2, three difficulty levels and three learning levels are used to describe the status of subject units and students. Assuming that the difficulty level is “Easy” and the learning level is “Naive”, the weight of  $IT_1$  is larger than that of  $IT_3$ , which implies that  $IT_1$  is more proper for the subject unit than  $IT_3$ . For difficulty level “Easy” and learning level “Naive”, the order of proper information technologies for the course is  $IT_1 > IT_3 > IT_4 > IT_2 > IT_6 = IT_7 > IT_5$ . Similarly, if the difficulty level is “Difficult” and the learning level is “Average”, the order is  $IT_4 > IT_5 > IT_6 > IT_3 > IT_1 > IT_2 = IT_7$ .

Table 1: Illustrative examples of information technologies

Information Technology	Definition	Application
Search Engine ( $IT_1$ )	Web-based programs for searching data on the Internet	Searching for supplement subject materials
BBS ( $IT_2$ )	Software systems to provide information exchange in public	Performing group-discussion on line Enabling announcement board for each class
E-mail ( $IT_3$ )	Software systems to provide the personal-to-personal information exchange with or without attached files.	Performing group-discussion on line Allowing the teacher to provide personal-consultant for each student Allowing students to discuss homework and to share information
Word Processor ( $IT_4$ )	Document editing software, such as Microsoft Word.	Enabling students to write reports
Presentations ( $IT_5$ )	Presentation software, such as Microsoft PowerPoint	Assist the teacher to make presentations to the students Enabling students to present homework to the teacher and the classmates
CAI ( $IT_6$ )	Computer-assisted instruction software.	Stimulating real-world phenomenon Offering drill and practice functions for some specific courses Offering testing and evaluation functions for some specific courses
Spreadsheets ( $IT_7$ )	Computer software that offers analysis and statistic functions on the data represented in tabular form, such as Microsoft Excel.	Assisting teachers and students to present analysis and statistic results, such as Pie charts or bar charts.

Table 2: Illustrative example of systematical model for conducting information technology applied instructions

Difficulty Level	Learning Level	Degrees of Fitness
Easy	Naive	$IT_1(a_1) > IT_3(a_3) > IT_4(a_4) > IT_2(a_2) > IT_6(a_6) = IT_7(a_7) > IT_5(a_5)$
	Average	$IT_2(a_2) > IT_1(a_1) = IT_6(a_6) > IT_3(a_3) = IT_4(a_4) > IT_5(a_5) > IT_7(a_7)$
	Good	$IT_6(a_6) > IT_4(a_4) > IT_1(a_1) > IT_3(a_3) > IT_7(a_7) > IT_2(a_2) > IT_5(a_5)$
Middle	Naive	$IT_2(a_2) > IT_3(a_3) > IT_4(a_4) > IT_7(a_7) > IT_6(a_6) > IT_1(a_1) = IT_5(a_5)$
	Average	$IT_1(a_1) > IT_6(a_6) > IT_7(a_7) = IT_2(a_2) > IT_3(a_3) = IT_5(a_5) > IT_4(a_4)$
	Good	$IT_3(a_3) > IT_7(a_7) > IT_4(a_4) > IT_2(a_2) > IT_1(a_1) > IT_5(a_5) > IT_6(a_6)$
Difficult	Naive	$IT_1(a_4) > IT_2(a_2) > IT_1(a_1) > IT_7(a_7) = IT_6(a_6) > IT_5(a_5) > IT_3(a_3)$
	Average	$IT_4(a_4) > IT_5(a_5) > IT_6(a_6) > IT_3(a_3) > IT_1(a_1) > IT_2(a_2) = IT_7(a_7)$
	Good	$IT_5(a_5) > IT_7(a_7) > IT_3(a_3) > IT_2(a_2) > IT_6(a_6) > IT_1(a_1) > IT_4(a_4)$

In addition to the difficulty levels of subject units and learning levels of students, there are several factors need to be taken into consideration while trying to apply information technologies to tutoring process. It is difficult for experienced teachers to arrange learning activities and tutoring strategies for information technology applied instruction without any aid.

To cope with this problem, in this paper, a systematical model for conducting information technology applied instructions is proposed based on the Analytic Hierarchy Process (AHP) method (Saaty 1977). AHP is a system analysis technique for solving decision-making problems. AHP provides a hierarchical framework within which multi-attribute decision problems can be structured. Its use of ratio scale along with paired relative comparison enables AHP to compare intangible attributes. AHP has the flexibility to combine quantitative and qualitative factors, to handle different groups of actors, to combine the opinions expressed by many experts, and can help in stakeholder analysis. As inexperienced teachers usually require step-by-step assistance in arranging proper information technologies while planning course contents, it can be seen that AHP is a simple and useful method to cope with this problem.

The methodology of AHP is basically to decompose a complex decision problem into elemental issue to create a hierarchical model. Application of AHP to a decision problem involves four steps (Ramanathan 2001):

**(1) Structuring of the decision problem into a hierarchical model:** In this step, the decision-making problem is decomposed into several elements according to their common characteristics and a hierarchical model with different levels is constructed. For example, Figure 1 shows a hierarchical model of mathematics course with 5 levels. The top three levels are “Course Design”, “Difficulty level” and “Learning level”. The fourth levels are effect factors to “Learning level”, such as “Computer Skill”, “Learning Achievement” and “Attitude of Learning”. And the lowest level contains some candidate alternatives of applied information technology, such as “Search Engine”, “BBS”, “E-mail”, “Word”, “PowerPoint”, “GSP” and “Excel”.

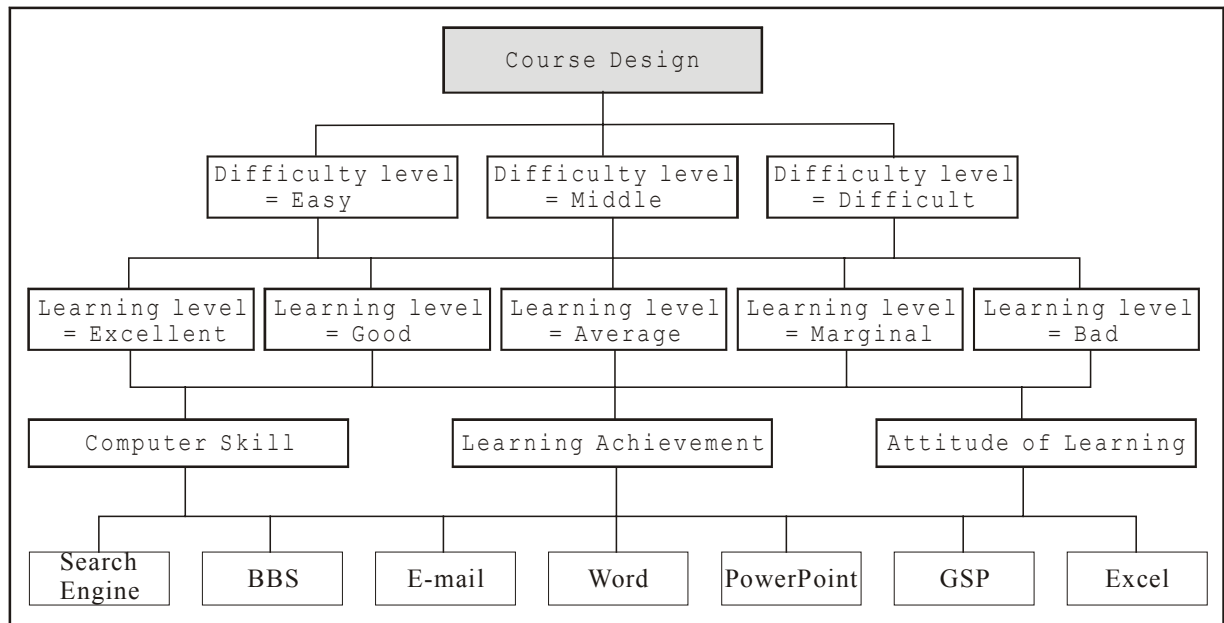


Figure1: Illustrative example of an AHP hierarchical model for mathematic course

**(2) Making pair-wise comparisons and obtaining the judgmental matrix:** In this step, the elements of a particular level are compared pair-wise, with respect to a specific element in the immediate upper level. For example, the pair-wise comparison matrix of the fourth level of the hierarchical model in Figure 1 is given in Table 3. The meaning of each value used in the matrix is described in Table 4 (Vargas 1990), where each value  $A_{ij}$  follows the rules:  $A_{ij} > 0$ ,  $A_{ij} = 1/A_{ji}$ ,  $A_{ii} = 1$  and  $X_j = \sum A_{ij}$ . For example, in Table 3,  $A_{11} = 1$ ,  $A_{22} = 1$ ,  $A_{33} = 1$ ,  $A_{12} = 1/7$ ,  $A_{21} = 7$ ,  $A_{13} = 1/3$ ,  $A_{31} = 3$ ,  $X_1 = (1+7+3) = 11$  and  $X_2 = (1/7+1+1/3) = 1.476$ .

Table 3: The pair-wise comparison matrix of fourth level.

$A_{ij}$	Computer Skill	Learning Achievement	Attitude of Learning
Computer Skill	1	1/7	1/3
Learning Achievement	7	1	3
Attitude of Learning	3	1/3	1
$X_j = \sum A_{ij}$	11	1.476	4.333

Table 4 The AHP comparison scale (Vargas 1990).

Intensity of importance	Definition	Description
1	Equal importance	Elements $A_i$ and $A_j$ are equally important
3	Weak importance of $A_i$ over $A_j$	Experience and judgment slightly favour $A_i$ over $A_j$
5	Essential or strong importance	Experience and judgment strongly favour $A_i$ over $A_j$
7	Demonstrated importance	$A_i$ is very strongly favoured over $A_j$
9	Absolute importance	The evidence favouring $A_i$ over $A_j$ is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate	When compromise is needed, values between two adjacent judgments are used
Reciprocals of the above judgments	If $A_i$ has one of the above judgments assigned to it when compared with $A_j$ , then $A_j$ has the reciprocal value when compared with $A_i$	

**(3) Determining local priorities and consistency of comparisons:** Before calculating the local priorities,  $B_{ij} = A_{ij}/X_j$  and  $Y_i = \sum B_{ij}/n$  need to be computed first. For example, in Table 5,  $B_{11} = 1/11 = 0.091$  and  $B_{12} = (1/7)/1.476 = 0.097$ ,  $Y_1 = (0.091+0.097+0.077)/3 = 0.088$  and  $Y_2 = (0.636+0.678+0.692)/3 = 0.669$ .

Table 5: Illustrative example of  $B_{ij}$ 's and  $Y_i$ 's

$B_{ij}$	Computer Skill	Learning Achievement	Attitude of Learning	$Y_i = \sum B_{ij}/n$
Computer Skill	0.091	0.097	0.077	0.088
Learning Achievement	0.636	0.678	0.692	0.669
Attitude of Learning	0.273	0.226	0.231	0.243

Matrix  $W_i$  is then calculated by summarizing the product of each column of matrix A, say  $A_i$ , and the corresponding  $Y_i$  as  $W = \sum Y_i \times A_i$ . For example,

$$W_i = 0.088 \times \begin{bmatrix} 1 \\ 7 \\ 3 \end{bmatrix} \square 0.669 \times \begin{bmatrix} 1/7 \\ 1 \\ 1/3 \end{bmatrix} \square 0.243 \times \begin{bmatrix} 1/3 \\ 3 \\ 1 \end{bmatrix} \square \begin{bmatrix} 0.265 \\ 2.014 \\ 0.73 \end{bmatrix}$$

The Consistency Ratio (CR) can then be calculated by

$$CR = \text{Consistency Index (CI)} / \text{Random Index (RI)},$$

where  $CI = (\lambda_{max} - m)/(m-1)$  for  $\lambda_{max} = [\sum (W_i/Y_i)]/m$ , and RI values for matrix size ranging from 1 to 8 can be found in Table 6 (Ramanathan 2001).

Table 6: Average consistencies of random matrices.

Size	1	2	3	4	5	6	7	8
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41

Therefore,  $\lambda_{max} = [(0.265/0.088)+(2.014/0.669)+(0.73/0.243)] / 3 = 3.008$ , and  $CI = (3.008 - 3)/(3-1) = 0.004$ . In the above example, matrix size is 3, and hence  $RI=0.58$ , and  $CR = 0.004 / 0.58 = 0.007$ . Since  $CR = 0.007 < 0.1$ , consistency of comparisons is acceptable.

**(4) Aggregation of local priorities:** After calculating  $W_i$  for each level of pair-wise comparison matrix, the final priority can be derived. Let  $W(P|Q)$  denotes the priority weight of P under the circumstance that Q is true. In the example given above, by assuming that difficulty level = "Easy" and learning level = "Excellent", the priority weight of  $IT_i$  is:

$$W[\text{Easy, Excellent, } IT_i] = W(\text{difficulty level is "Easy"}) \times W(\text{learning level is "Excellent"} | \text{difficulty level is "Easy"}) \times W(\text{"IT}_i" | \text{"Computer skill"} | \text{learning level is "Excellent"}) \times W(\text{"IT}_i" | \text{"Computer skill"}) \square W(\text{difficulty level is "Easy"}) \times W(\text{learning level is "Excellent"} | \text{difficulty level is "Easy"}) \times W(\text{"Learning achievement"} | \text{learning level is "Excellent"}) \times W(\text{"IT}_i" | \text{"Learning achievement"}) \square W(\text{difficulty level is "Easy"}) \times W(\text{learning level is "Excellent"} | \text{difficulty level is "Easy"}) \times W(\text{"Attitude of learning"} | \text{learning level is "Excellent"}) \times W(\text{"IT}_i" | \text{"Attitude of learning"})$$

After deriving the weight of each  $IT_i$ , the priorities of applying different information technologies under some specified considerations can be obtained.



The flowchart of the systematical model for conducting information technology applied instructions is given in Figure 2, which consists of ten steps as follows:

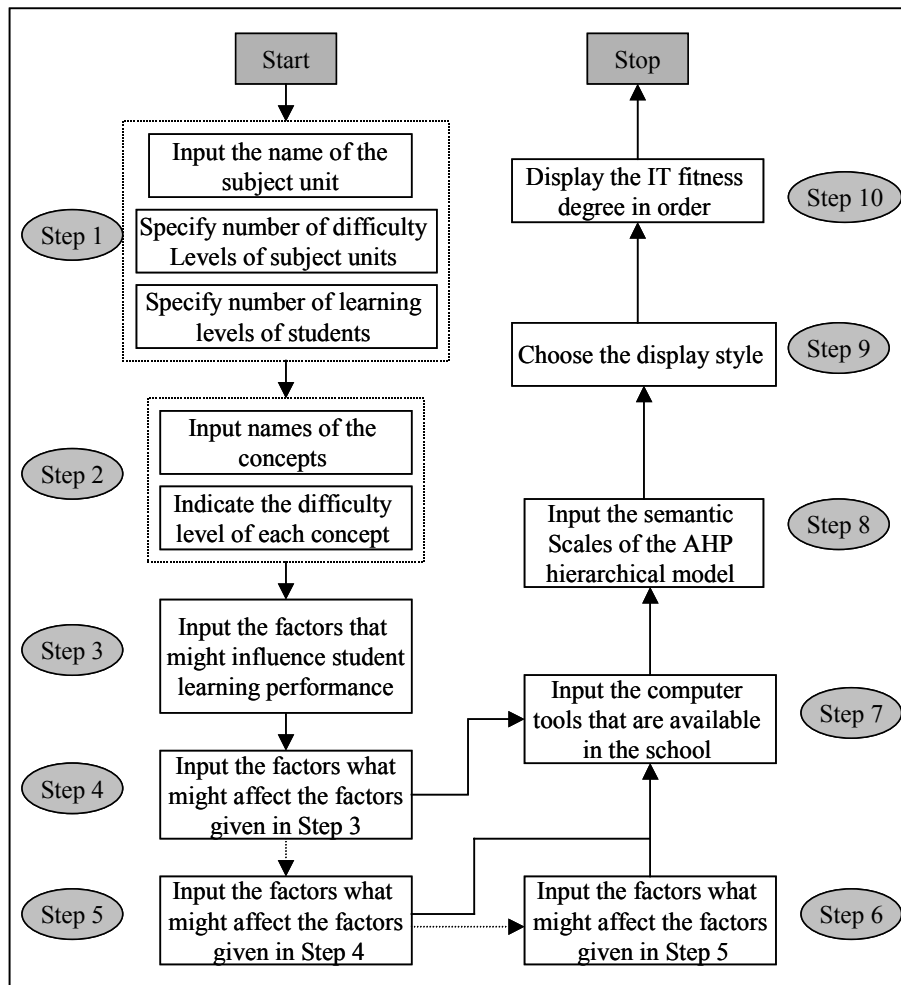


Figure 2: Flowchart of the systematical model.

**Step 1:** Input the name of the subject unit and specify number of difficulty levels of subject units (3, 5 or 7) and learning levels of students (3, 5 or 7). For example, if the teacher chooses “3” as the number of difficulty levels, it implies that the candidate difficulty levels are “Easy”, “Middle” and “Difficulty”. If the teachers chooses “5” as the number of learning levels, the candidate learning levels are “Excellent”, “Good”, “Average”, “Marginal” and “Naive”.

**Step 2:** Input names of the concepts in the subject unit and indicate the difficulty level of each concept.

**Step 3:** Input the factor that might influence student learning performance, such as attitude of learning, computer skills and mathematics background.

**Steps 4- 6:** Input the factors what might affect the factors given in Step 3. Consequently, the teacher is asked to input the factors what might affect the factors given in Steps 4 and 5.

**Step 7:** Input the computer tools that are available in the school. Those computer tools are the candidate information technologies that might be applied to the tutoring process of the course.

**Step 8:** Input the semantic scales of the AHP hierarchical model. I-Design will make pair-wise comparisons and present the analysis results according to the input semantic scale.

**Step 9:** Choose the display style. Two display modes are provided: tabular mode rule-like mode.

**Step 10:** Display the IT fitness degree in order. For example, the following rule might be generated after performing the AHP analysis:

**IF** Subject unit “Parallel” and  
Concept “Parallelogram” and  
Difficulty level is “difficult” and  
Learning level is “excellent”  
**THEN** Search Engine(21) > BBS(19) > E-mail(17) > Microsoft Excel(15) > Microsoft Word(14) > Microsoft PowerPoint(13) = GSP(13)

This rule shows that the priority weights of Search Engine, BBS, E-mail, Microsoft Excel, Microsoft Word, Microsoft PowerPoint and GSP are 21, 19, 17, 15, 14, 13 and 13, respectively. Consequently, Search Engine is a more suitable tool for learning “Parallelogram” than BBS, and BBS is more suitable than E-mail... etc.

#### 4. Implementation of I-Designer

Based on the proposed model, I-Designer, a web-based computer-assisted system for conducting information technology applied instructions has been implemented. I-Designer aims to assist inexperienced teachers to plan learning actives and course contents for applying information technologies to improve student learning performance. The homepage of I-Designer is shown in Figure 3.

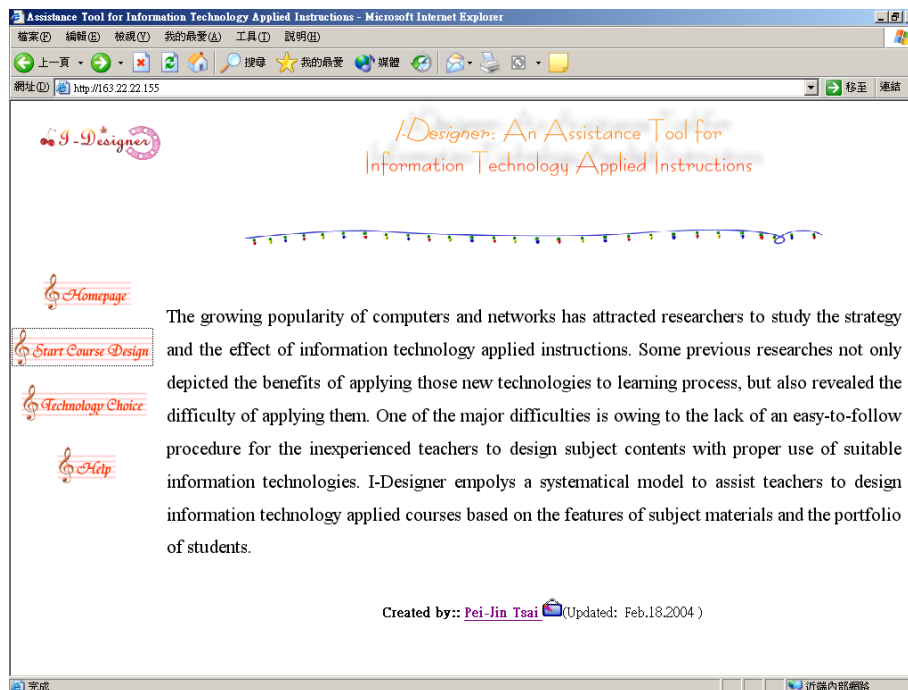


Figure 3:Homepage of I-Designer

Figure 4 shows the user interfaces for inputting concepts and the corresponding difficulty levels. Figure 5 demonstrates the user interface for inputting the semantic scale of the AHP hierarchical model. Figure 6 presents the analysis results.

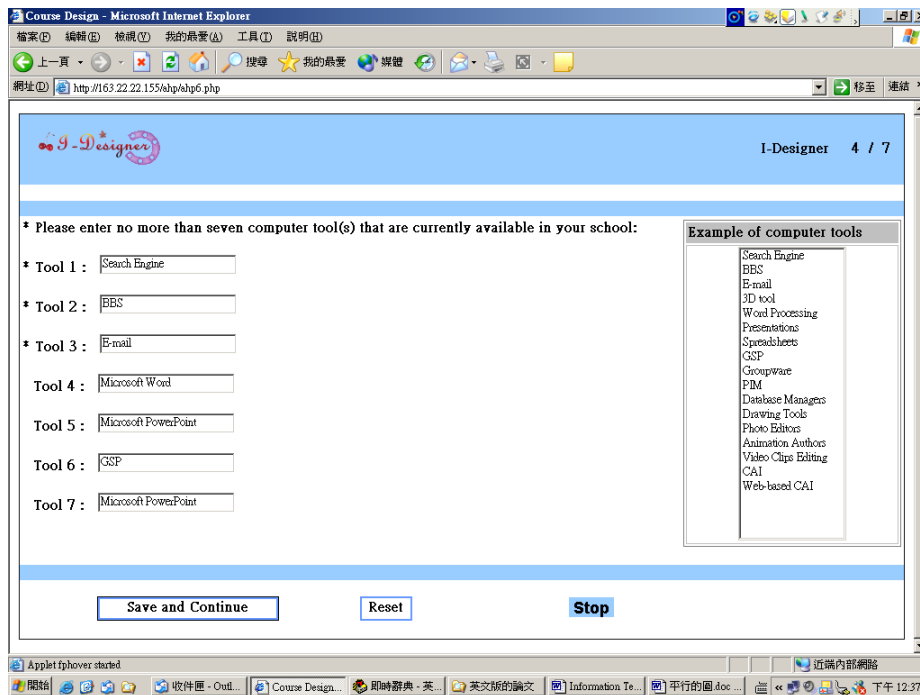


Figure 4: User interfaces for inputting the candidate computer tools

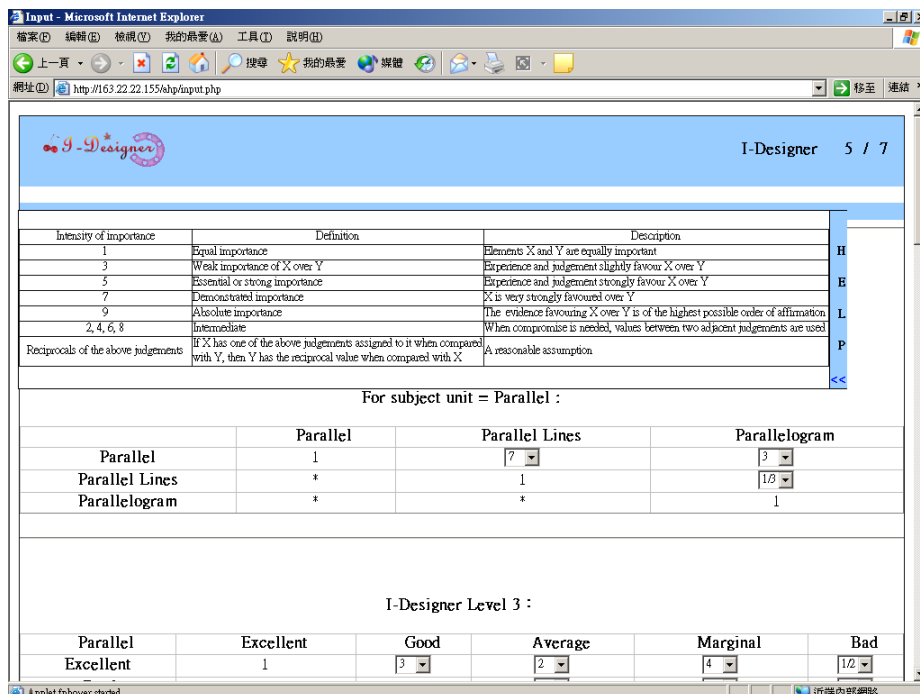


Figure 5: User interface for inputting the semantic scales of the AHP hierarchical model

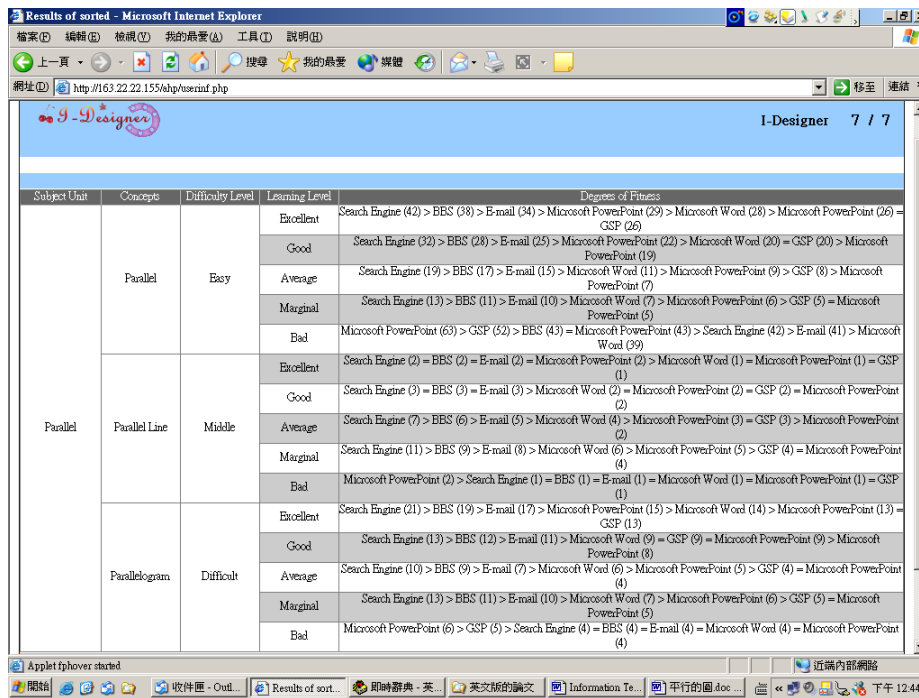


Figure 6: Analysis results of I-Design.

## 5. Experiments and Evaluation

To evaluate the efficacy for conducting information technology applied instructions, an experiment was conducted from March 2003 to June 2003 on a nature science course of junior high school. One hundred and twenty-eight students participated in the experiment, and were separated into two groups, each of which contained sixty-four students.

The pre-test aims to ensure that the students in control group and experimental group have the equivalent basis for learning the course. The test sheet of the pre-test contained twenty multiple-choice questions. The t-test for the pre-test results of control group and experimental group is shown in Table 7. The t-value is  $-0.891$  and p-value is  $0.374$ . Consequently, the pre-test results of control group and experimental group are not significant at a confidence interval of 95%. That is, the students in the control group and the experimental group have the equivalent ability when learning the course.

Table 7: Statistic results of pre-test

	Control Group	Experimental Group
N	64	64
Mean	6.31	5.94
Std. Dev.	2.363	2.396
$t=-0.891$ sig.=0.374		

After three months, a post-test was performed to compare the learning performance of the students in both groups. In this test, the students received twenty Multiple-Choice questions too. The t-test for the post-test results of control group and experimental group is shown in Table 8. The t-value is  $4.222$  and p-value is  $0.000$ . Consequently, the post-test results of control group and experimental group are significant at a confidence interval of 95%. From the experimental results, it can be seen that the students in experimental group have achieved significantly

improved performance than that of control group in learning of the nature science course, and hence we conclude the new approach is helpful in enhancing student learning efficacy.

Table 8: Statistic results of post-test

	Control Group	Experimental Group
N	64	64
Mean	9.56	12.73
Std. Dev.	4.059	4.434
t=4.222 sig.=0.000		

In additions, 33 teachers and 70 students who ever participated in several tutoring activities constructed by I-Designer were asked to fill out the questionnaires. Table 1 shows the analysis results of questionnaires for teachers. It can be seen that over 90% teachers indicated that the designed tutoring contents were able to promote learning motives and to help the students to understand the subject contents.

Table 2 shows the analysis results of questionnaires for students. It can be seen that over 80% students agreed that the designed tutoring contents could promote their learning motives and was helpful to them to understand the subject contents. Moreover, 84% of the students would like to receive the courses with similar tutoring style in the future. Consequently, we conclude that I-Design is helpful in enhancing student learning efficacy.

Table 1: The result of questionnaire for teachers

Question	Strongly Disagree	Disagree	Average	Agree	Strongly Agree
The planned tutoring contents are able to promote learning motives.	0%	0%	6.1%	9.1%	84.8%
The planned tutoring strategy is helpful to the students to understand the subject contents	0%	0%	9.1%	12.1%	78.8%

Table 2: The result of questionnaire for students.

Question	Strongly Disagree	Disagree	Average	Agree	Strongly Agree
The planned tutoring contents are able to promote learning motives.	0%	8.6%	11.4%	32.9%	47.1%
The planned tutoring contents are helpful to the students to understand the subject contents	0%	4.1%	14.3%	24.8%	56.8%
Would you like to receive courses with similar tutoring style in the future?	0%	7.4%	8.6%	31.1%	52.9%

## 6. Conclusion

In this paper, a systematical model for conducting information technology applied instructions is proposed. Moreover, a web-based system has been developed based on the proposed model. To evaluate the performance of the novel approach, some experiments have been conducted on Mathematics course and Nature Science course of a junior high school. Experimental results showed that the approach is able to associate subject materials with proper information technologies and hence the students significantly appreciated the learning process. Moreover, the t-test results of the pre-test and the post-test have shown that the systematical model for conducting information technology applied instruction in the experimental group have achieved significantly better improvement than those in the control group. Therefore, we conclude that the new approach is helpful in enhancing students learning performance.

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