**The Hashemite Kingdom of Jordan**
**Ministry of Education**

**Japan International Cooperation Agency**

# The Study on Digital Self-Learning Material Development

## Final Report

## Summary

JULY 2003

PADECO
PADECO CO., LTD.

# THE HASHEMITE KINGDOM OF JORDAN
# THE STUDY ON DIGITAL SELF-LEARNING MATERIAL DEVELOPMENT
## FINAL REPORT

## SUMMARY

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# EXECUTIVE SUMMARY

Though Jordan has achieved a fair level of provision in IT infrastructure and hardware, the introduction of IT to education has potential for development. Thus the Government of the Hashemite Kingdom of Jordan requested to the Government of Japan to provide "the Study on Digital Self-Learning Material Development in Jordan" in accordance with the Agreement on Technical Cooperation between the Government of Jordan and the Government of Japan signed on July 16, 1985. Accordingly, the Japan International Cooperation Agency (JICA), the official agency responsible for technical cooperation, invited tenders and PADECO Co., Ltd. of Tokyo, Japan (PADECO) was selected to carry out the Study. A team of experts from PADECO was mobilized in early May 2002, and commenced their work in Amman, which continued till May 2003.

The overall objective of the study, specified by the Scope of Work, is to develop the capability of the government of Jordan to plan, specify, and order digital teaching materials from private developers or constructors. Taking a two-month unit of Physics in Grade 11 as a sample, the study provides the government with practical experience in digitization of the textbook through a process of analysis, specification, development, implementation, and evaluation. Through this hands-on process, the government can foster the ability to digitize other subjects. Thus, the specific aims of the Study are:

i) to digitize a two-month unit of Physics Grade 11, and to propose this as a model for further digitization of educational materials;

ii) to tie in the digitization of educational materials with the shift from teacher-oriented methodology to student-oriented methodology;

iii) to use the digital learning material to encourage and motivate students to actively gain an improved understanding of learning contents and deepen their understanding;

iv) to prepare a Handbook for reference to facilitate adequate replication of the digitization process to other teaching materials; and

v) to train the Counterparts to digitize other teaching materials in an efficient and competent manner.

For the beneficiaries of the project, the Directorate of Curricula and School Textbook (as the counterpart agency and task force team) and experienced teachers in physics (as taskforce team members) were identified as the direct beneficiaries, while the effects would also be realized by i) students and teachers in each school, ii) supervisors of each local bureau, and iii) other staff in the Ministry of Education. A task force team was formed by the Ministry of Education to achieve the smooth transfer of skill and thus realize the objectives of the study. This team included one officer from the Directorate of Curricula and School Textbooks in the Ministry of Education and experienced physics teachers and supervisors with various backgrounds.

As for the first task, the textbook analysis sought to clarify the educational aims and objectives of each Chapter, Section, and Content & Activity of a textbook, and to set out the relevant content in a form for

ease of digitization. During the process of textbook analysis, 'analysis sheets' were developed for each objective described above. In selecting appropriate chapters to include as digital materials, the following factors were considered: i) the timing of the pilot period, scheduled for February and March 2003 and ii) the effectiveness of digitizing material in producing self-learning materials. As a result, Chapters 9 and 10 were chosen for textbook analysis.

In the process of designing digital self-learning material following textbook analysis, tasks were performed in three distinctive phases: i) Basic Design, ii) Course Design, and iii) Detailed Design. The theory and method of the adopted development process, called instructional design, was introduced on a hands-on basis as a skill transfer to the task force team members. The Design followed the Waterfall Model, which is a typical computer software development method. In this model all Basic Design and Course Design must be done before Detailed Design. However, as the counterpart team was not familiar with the design tasks, it was difficult to design the outline of contents with imaging details. Therefore, the team took the following approach to the schedule: i) 24 units were divided into 5 groups comprising four or five Units each; ii) the design of each group included Course Design and Detailed Design; and iii) the duration for design of the first group was longer than the others. In the end, the JICA team reviewed the output of the Detailed Design and found a number of points requiring improvement, which were later incorporated.

During the digital material development, the JICA Study Team executed three tenders, namely for: i) the digital self-learning contents development; ii) the equipment; and iii) the evaluation and analysis of self-learning material development. For each tender, one local company in Jordan was selected through a clear and fair procedure. Moreover, the Counterpart gained specific techniques and knowledge concerning how to execute a tender through these procedures. Following the design phase, the Counterpart and the Subcontractor (Menhaj Technologies) carried out the development of the digital material in close cooperation. Various development management processes, such as i) task management, ii) quality management, iii) schedule management, and iv) organization management, were introduced. As a result of this management and much effort from the Counterpart and the Subcontractor, the final development output proved excellent in quality and quantity. After the development, an Acceptance Test was executed to confirm that the self-learning material was developed according to all specifications and requirements of the JICA Study Team. It detected 15 simple errors and the Subcontractor accomplished all necessary corrections.

For the selection of schools subject to trial application, the Task Force Team defined the following conditions such as location, gender equity, minimum number of classes and students, and PC connectivity. Based on thorough discussions with the staff of the Directorate of Curricula and School Textbooks, two boys schools (Omar Bin El-Khatab and Irbid Secondary) and two girls schools (Al Jaloot and Noor Al-Hussein) were selected. Through the preparation of the trial in these schools, school profiles were gathered, teacher training was organized in Amman, installation of digital material was implemented, and a baseline survey was organized. As these activities went well, the trial lesson was implemented for lessons from 18th of February to 20th of April and 3 lessons a week were given to about 400 students. The trial comprised the following conditions: i) self-learning with digital material ii) ordinary lesson with show of digital material, and iii) ordinary lesson. Counterparts joined the lessons and assisted physics teachers. The summarized results of the trial are: i) the students in the first condition,

the self-learning with digital material, gained the best score especially in the problem solving skills; ii) those in the first condition also improved their understanding of physics formulae; iii) many students had high expectations of the digital self-learning material and these expectation did not change after the trial; and iv) many students thought that the digital material was effective for understanding the complicated formulae. In this phase the Subcontractor (ICM: The International Center for Management and Leadership Development) carried out data-collection and analysis.

To spread the knowledge and skills that the Counterpart had gained in this project, the JICA Study Team organized a two-day workshop in Amman during 22nd and 23rd of May 2003. This workshop reported the results of the trial including: i) effect of the digital materials; and ii) practice in school. Also, it was aimed at teaching attendees how to use the digital materials that the project had developed.

In the end, the JICA Study Team gave recommendations on the issues of i) the government's role, ii) development of digital material, and iii) the future path. The first recommendation pointed out expected basic areas of government responsibility in IT and education, suggested development organization, and the importance of comprehensive planning and human resource development planning. Based on the actual problems the Counterpart faced, the second topic of recommendation discussed the importance of the development management and textbook analysis, pointed out simpler design activities, suggested keeping the fairness in the tender process with sample demonstrations, proposed counter measures to losing time due to poor communication between programmers and designers, such as i) debugging at document basis, ii) statistical control of errors, and iii) setting of clear deadlines, and finally suggested to develop a system of automatic execution of monitoring and feedback and to analyze finer reactions of students by making films of students' behavior and carry out video analysis, although no such attempt was made in this project. For the third recommendation, the results of this project showed the possibility for Jordan to lead the world in this field. They showed that Jordan can attain the top position if education reform is preceded by i) plans centered around the capability improvement of teachers and MOE officials, and provision of an appropriate environment and systems supporting individual initiatives; ii) identifying students' initiative as the central target of learning and a system to support this by IT technologies; and iii) varied application of IT not limited to digital materials.

# 1

# INTRODUCTION

## 1.1 Background

Jordan has been through difficult economic circumstances. As creating wealth through domestic industry is a key issue, His Majesty the King Abdullah Bin Al-Hussein has been taking the lead promoting and introducing IT business, free trade, and foreign investment. Human resource development is important to achieve these goals. So Jordan has planned to apply IT into education sector for not only to enhance IT education but also to reform all subjects, especially science area.

Though Jordan has achieved a fair level of provision in IT infrastructure and hardware, the introduction of IT to education is seen to have a large potential for development. Thus the Government of the Hashemite Kingdom of Jordan requested to the Government of Japan to provide "the Study on Digital Self-Learning Material Development in Jordan" in accordance with the Agreement on Technical Cooperation between the Government of Jordan and the Government of Japan signed on July 16, 1985.

Accordingly, the Japan International Cooperation Agency (JICA), the official agency responsible for the technical cooperation invited tenders and PADECO Co., Ltd. of Tokyo, Japan (PADECO) was selected to carry out the Study. A team of experts from PADECO was mobilized in early May 2002, and commenced their work in Amman, which continued until May 2003.

## 1.2 Objectives and Targets

### 1.2.1 Aims and Objectives

The overall objective of the study, specified by the Scope of Work, is to develop the capability of the government of Jordan to plan, specify, and order digital teaching materials to private developers or constructors. Taking two-month units of physics in Grade 11 as a sample, the study gives to the government practical experience in digitization of the textbook with a process of analysis, specification, development, implementation, and evaluation. Through this hands-on process, the government can foster the ability to digitize other subjects.

Thus, the specific aims of the Study are:

- To digitize a two-month unit of Physics Grade 11, and to propose this as a model for further digitization of educational materials;

- To tie in the digitization of educational materials with the shift from teacher-oriented methodology to student-oriented methodology;

- To use the digital learning material to encourage and motivate students to actively gain an improved understanding of learning contents and deepen their understanding;

- To prepare a Handbook for reference to facilitate adequate replication of the digitization process to other teaching materials;

- To train the Counterparts to digitize other teaching materials in an efficient and competent manner.

### 1.2.2 Beneficiaries

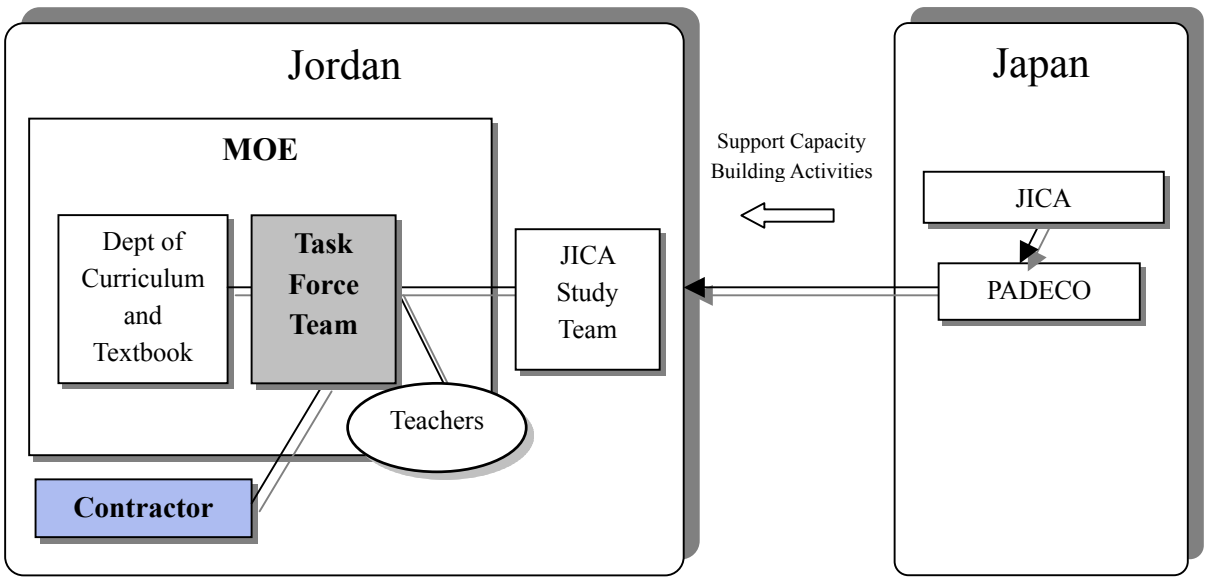
Beneficiaries of the study are the following:

1) Direct Beneficiaries
   Directorate of Curricula and School Textbook (as the counterpart agency and task force team)
   Experienced teachers in physics (as taskforce team member)
2) Indirect Beneficiaries
   Students and teachers in each school
   Supervisors of each local bureau
   Other staff in the Ministry of Education

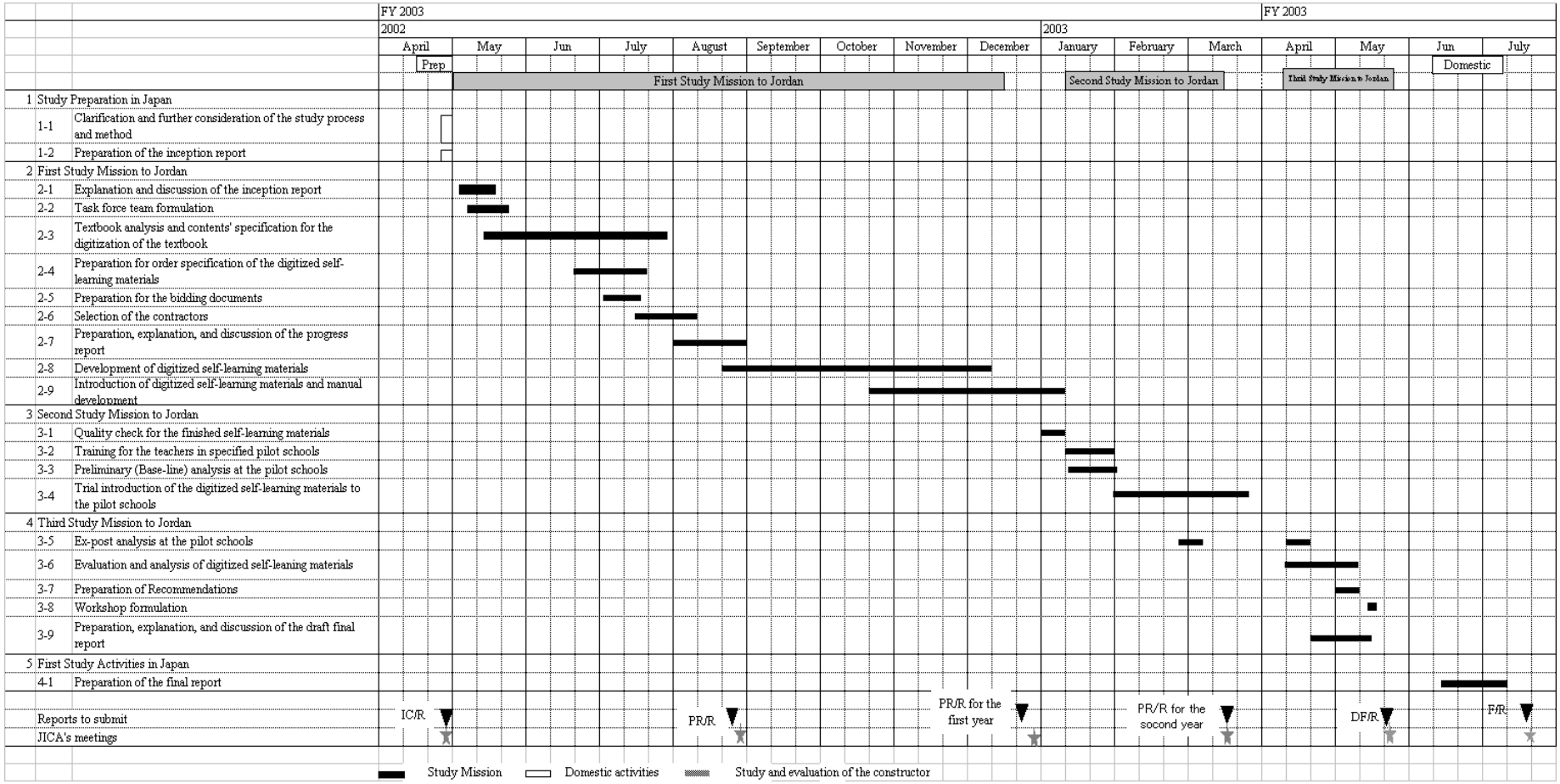
## 1.3 Study Organization

A task force team was formed by the Ministry of Education to achieve the smooth transfer of skill and thus realize the objectives of the study. This team included one officer from the Directorate of Curricula and School Textbooks in the Ministry of Education and experienced physics teachers with various backgrounds. Cooperation among members of both the Study Team and the task force team and their full devotion toward the study were the key to its success.

**Figure 1.3.1 Relationship between Organizations in Jordan and Japan**



## Figure 1.4.2 Final Schedule of the Study



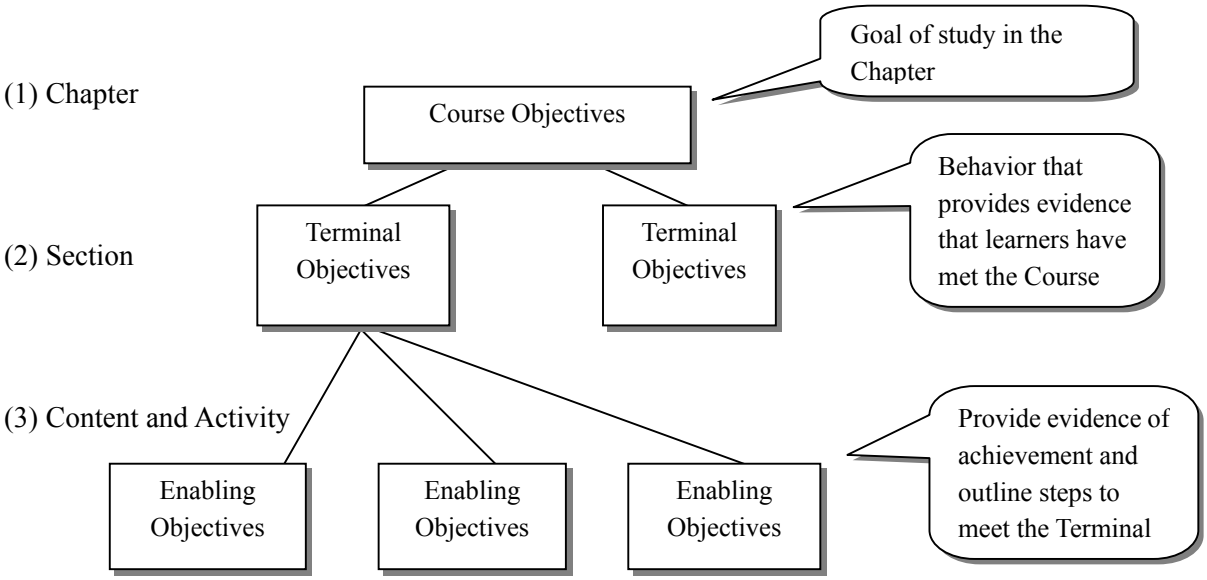
# 2

# ANALYSIS OF EXISTING TEXTBOOK

## 2.1 Objectives and Method

### 2.1.1 Objectives

A textbook has a hierarchical structure containing chapters, sections, which in turn have content comprising concepts, rules, definitions and exercises. Textbook analysis[1] seeks to clarify the educational aims and objectives of each Chapter, Section, and Content & Activity of a textbook, and to set out the relevant content in a form for ease of digitization.
The objectives are different for each stage of the textbook hierarchy as illustrated below:




### 2.1.2 Method of Analysis

During the process of textbook analysis, 'analysis sheets are developed for each objective described above. The first sheet will provide information on the Chapter and an overview of the goals and materials.

[1] The term 'curriculum analysis' is widely used and refers to a comprehensive approach. However, the term 'textbook analysis' is used in this study as the main analysis focuses solely on the textbook. Notwithstanding, supplemental materials were also analyzed to enrich digitized material.

## 2.2 Process of Textbook Analysis

### 2.2.1 Selection of Chapters for Digital Materials

The newly developed Grade 11 Physics textbook comprises with ten chapters. In selecting appropriate chapters to include as digital materials, the following factors were considered:

1) The timing of the pilot period, scheduled for February and March 2003.
2) The effectiveness of digitizing material in producing self-learning materials.

As a result, as Chapters 9 and 10 were chosen during the period of textbook analysis.

### 2.2.2 Process of Analysis

The role of the Study Team was to manage the analysis schedule and to instruct the analysts on how to analyze the textbook. To support the analytical work, the team developed a handbook to standardize the analysis with ten format types (see Table 2.2.1). This format sheets was used for the analysis and the analyst team completed the format sheets through discussion. Completed sheets were then translated into English and stored on digital file.

In the first week, the formats defining objectives and goals were completed, then in the following week, the format describing teaching-learning contents, exercise and practice, concept and terminology and supplemental materials were completed. Some difficulties in agreeing the form of output were as follows;

- Should the analysis only focus on the textbook itself?
- Should analysts write suggestions on the sheet with proposed images of digitized material?

The handbook format was further developed and modified for convenient use by the analysts. The handbook can be readily utilized when the Ministry expands digitization to whole chapters in Physics and other subjects.

**Table 2.2.1 List of Analysis Formats**

| |
|---|
| Type of Analysis Format: Definition of Objectives and Goals |
| Specification of Material (Objectives and Overview of Chapter) |
| Terminal Objectives |
| Enabling Objectives |
| Type of Analysis Format: Contents and Terms |
| Teaching-learning Contents |
| List of Teaching-learning Contents |
| Concept / terminology |
| Type of Analysis Format: Exercise and Practice |
| Exercise and Quiz |
| List of Exercise and Quiz |
| Type of Analysis Format: Supplementary Materials |

# 3

# CONTENTS DESIGN

## 3.1 Design Procedure

### 3.1.1 Scope of work

Figure 3.1.1 illustrates the difference among these design phases.

1) Basic Design

Basic design determines the overall development policy and defines an outline of the first mention of e-learning system and contents. The outline depends on the learning-environment, national curriculum outlines, national educational policy and features of targeted subjects.

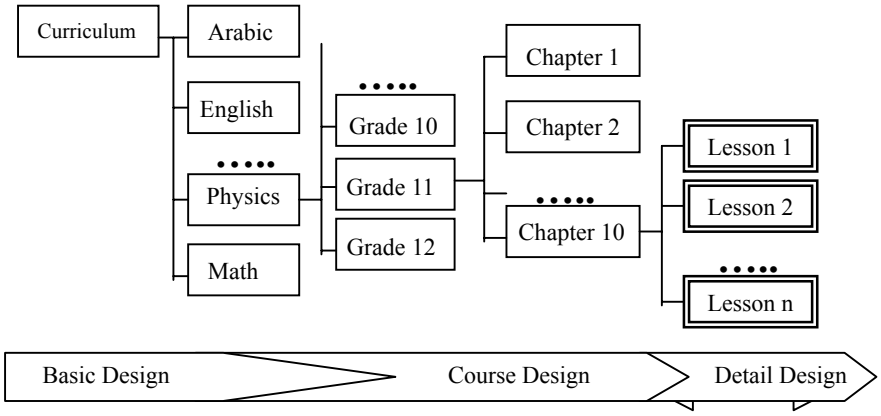
2) Course Design

Course design defines the structure and the teaching method of contents. In this project, the team changed textbook contents into appropriate digital material units (Lessons) and defined teaching methods for each lesson.

3) Detailed Design

Detailed design consists of designs defining display, question, animation, narration, movie, simulation, and learning sequence.

**Figure 3.1.1 Difference Succession Designs**



### 3.1.2 Design Form and Task Allocation

Instructional Design is a collection of development and management methods of e-learning and digital materials. It usually provides design forms and management forms. The JICA team made these forms for the project. The task of the design phase is to make the documents in accordance with these forms.

The Design follows the water-fall model which is a typical computer software development method, alternatively called 'Top – Down Design', as shown in Figure 3.1.2.
(Table 3.1.1 is the list of all document forms. )

**Figure 3.1.2 Relationships among Documents**

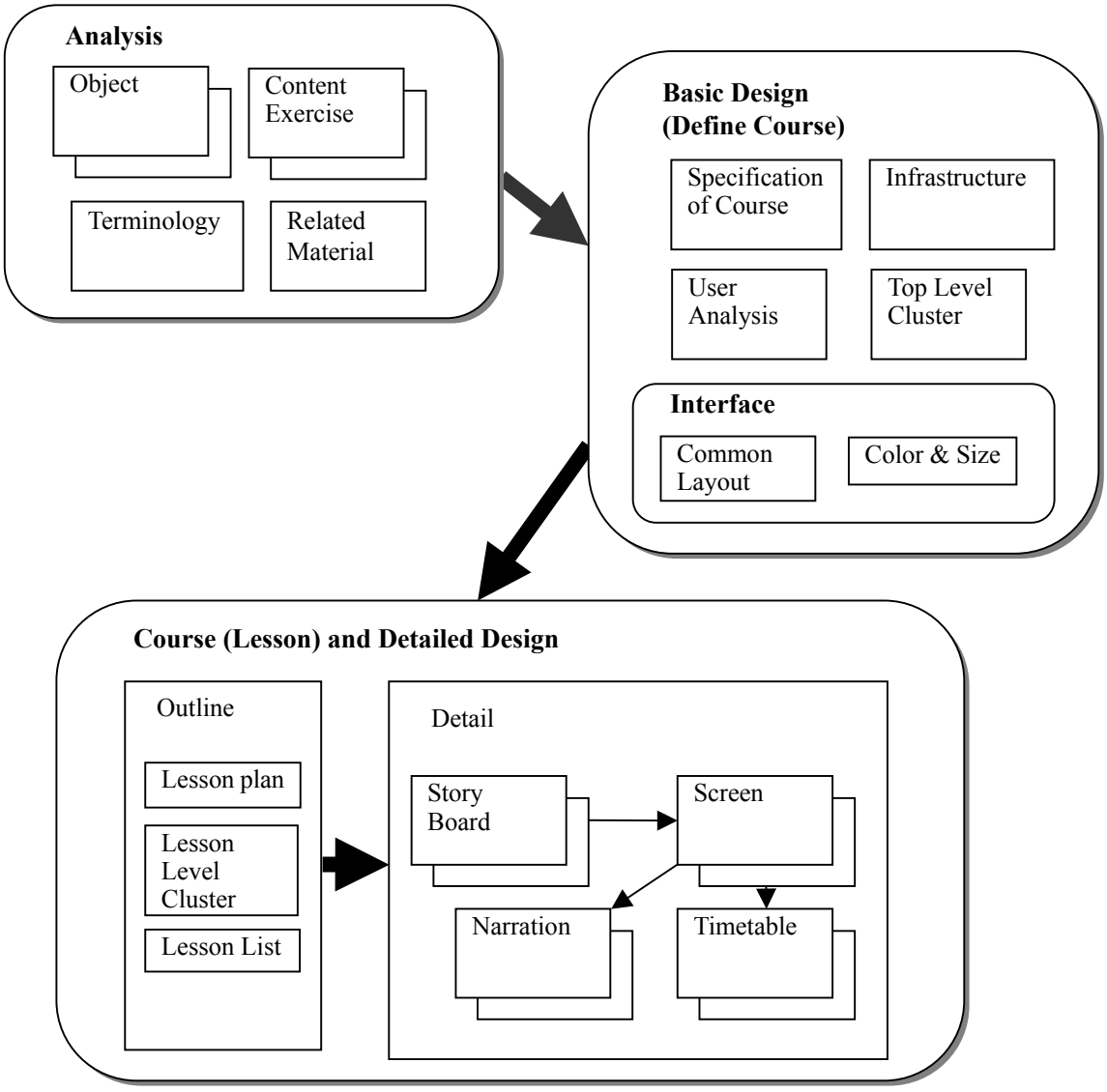


**Table 3.1.1 List of Design Form and Task Allocation**

(Task Allocation ** Primary Responsibility ++ Production -- Verification

| Phase | Document name | File name | To use | Task Allocation | | |
|---|---|---|---|---|---|---|
| | | | | JICA-PADECO | Counter part | Contractor |
| Basic Design | Infrastructure | P_Infrastructure.doc | Describe a PC & network environment & development tools | ** | -- | |
| | Specification of Course | B_SpecCours.doc | Describe specifications of course | ** | -- | |
| | Lesson List | B_LessonList.doc | Describe a summary of lessons | -- | ** | |
| | Top Level Cluster | B_Cluster.doc | Describe a top level structure of digital material | ** | -- | |
| Basic Design (Interface) | Common Layout | B_Layout.doc | Describe a common screen layout | ** | -- | ++ |
| | Color &Font | CD_ColorSize.doc | Define color & font size | ** | -- | ++ |
| Course (Lesson) Design | Lesson plan | B_LessonPlan.doc | Describe lesson plan of a lessen | -- | ** | |
| | Lesson Level Cluster | B_Cluster.doc | Describe a lesson level structure of digital material | -- | ** | |
| Detailed Design | Story board | CD_storyboard.doc | Describe a continuity of content | -- | ** | |
| | Screen | D_screen.doc | Define text, graphic, etc… | -- | ** | |
| | Time Line | D_timeline.doc | Define a sequence of materials | -- | ** | |
| | Narration | D_narration.doc | Define a narration | -- | ** | |
| | Glossary | D_glossary.doc | Define a glossary | -- | ** | |
| | Reference List | D_referencelist.doc | Define a reference | -- | ** | |

### 3.1.3 Study Team Lectures

The Digital contents designer must be adequately equipped with educational technology and ICT. Because the JICA team found the level of the counterpart team in this field inadequate. JICA team gave a series of training lectures to the counterpart team. (see Table 3.1.2).

**Table 3.1.2 Lecture Schedule**

| Date | Lecture Title | Category | | |
|---|---|---|---|---|
| | | Education | e-learning | ICT |
| 2002/05/09 | Collaboration Tool | | + | + |
| 2002/05/12 | e-Learning Developing Tools & Software | | + | + |
| 2002/05/13 | Type of contents | | + | |
| 2002/05/14 | Developing Methods & Cost | | | + |
| 2002/05/16 | Curriculum Analysis | + | + | |
| 2002/05/19 | Network Security | | | + |
| 2002/05/20 | Media and Delivery of Contents | + | + | + |
| 2002/05/21 | Phase of contents development | | + | |
| 2002/05/26 | How to Design contents | + | + | + |
| 2002/05/26 | Multi Media Data | + | + | + |
| 2002/05/30 | Types of Question (Test) on Web | + | + | + |
| 2002/06/01 | Management & Detailed Design | + | + | |
| 2002/06/04 | International School Collaboration | + | + | |
| 2002/06/09 | Internet and Intranet | | | + |
| 2002/06/16 | Tips of Digital Material | + | + | + |
| 2002/06/19 | LAN and Sharing | | | + |
| 2002/06/24 | Case Study (Develop management) | | + | |
| 2002/06/26 | Detail of Project Schedule | | + | |
| 2002/06/30 | Standards of e-Learning | + | + | |

## 3.2 Basic Design of Contents

### 3.2.1 Tasks of Basic Design

1) Determination of the learning operation environment

The team surveyed and analyzed i) network (the Internet and intranet), and ii) PC specification in order to recognize and decide what kind of digital materials could be used in schools.

2) Determination of target students and teachers

The team assumed the capability of students and teachers for the purpose of design work. However, it is possible to examine their background including their academic achievement level for the selected subject, their IT capability and their motivation.

3) Selection of the development approach

The task force team selected educational software types for self-learning materials and development tools and software. General types of educational software are shown in Table 3.2.1.

**Table 3.2.1 Classification of Educational Software**

| Type of software | Description |
|---|---|
| Tutorial | Presents explanations and questions. e.g. CAI |
| Simulation | Students can change parameters and configuration and observe the effect of the change. e.g. experiments in physics. |
| Drill | By urging students to answer questions, it enables students to increase and establish their knowledge. |
| Presentation | Using computer graphics, it explains contents that are difficult to understand in fixed pictures and books. e.g. the movement of planets. |
| Game | Enables students to actively learn by playing games with specific rules. |
| Illustrated reference | Integrates fixed pictures, animation, sound as a reference book. |
| Tools | Enables students to search their own interest. |
| Edutainment | Has both education and entertainment factors. Students can learn with enjoyment. |

Source: Center for Educational Computing, *Classification of educational software libraries.*

4) Design of the general user interface and data collection

This task involved designing common and general user interfaces with the view of usability and ease of observation. It also included the supplementary any design of glossary, collaboration tools, map and so forth.

5) Course division and general design

This task divided whole materials into appropriate courses based on time and contents. Each course is limited to a-few-hour contents and solitary units. The task also included designing basic learning strategies and composition of each course.

### 3.2.2 Development Policies

The outline and development policies for the contents design were determined after surveys and discussions considering the features of this project. All designs followed these policies.

1) Media and Delivery of Contents

The digital self-learning materials are to be stored in a server PC in PC room in each school. Every student's PC can access these materials as Files or Web-files, which are made as HTML-files. Besides, in order to collect log data, the materials use Web server program functions.

2) Using Programs and Multimedia

The digital material contains animation and simulation programs, movie, voice, and music. Because the learning operation environment is assumed as a LAN (100Mbps), the material can use high-quality multi media data with a large capacity requirement. However, this material can not be used in the narrow band Internet.

3) Language and Tools

HTML and Flash are major development methods for e-learning and the team adopted them. Some contents may have difficult simulations, which may be written in Java.

4) Teaching Method

The digital material often adopts a 'tutorial mode' as only pedagogical method. For the purpose of improving the active and positive learning style of students, the team adopted other methods such as simulation, question and analysis, real experiment, and so forth.

5) Fast Leaner and Slow Learner

It is important to accommodate the different learning speeds of both fast learners and slow learners in the same material. The team concluded that the contents would have two types of materials, one is the basic content and the other is the advanced contents. We assume that the slow learner can study the basic contents, and the fast learner can study both in the same time period.

6) Collaboration

Collaboration, i.e. collaborative learning among students, is the keyword in recent education discussion. Self-learning tools should be designed with collaboration in mind such as discussion among students.

The team prepared a Bulletin Board System (BBS) in the PC room.

7) Course Division

The target of the self-learning materials is a two-month unit of physics in grade 11 (Chapter 9, 10 in textbook), and the team divided these contents into 24 units, called Lessons, in the project. Each Lesson takes 1 lesson hour (45 min) in class. The Table 3.2.2 shows the relation of lessons between textbook and self-learning material.

**Table 3.2.2 List of Lessons**

| Chapter | Text Book | | | Self-learning Material | | |
|---|---|---|---|---|---|---|
| | No | Section | Time | No | Lesson | Time |
| Chapter 9 | 1 | Interaction of light with matter | 2 | 1 | Reflection<br>Absorption of light | 1 |
| | | | | 2 | Transmission of light | 1 |
| | 2 | Reflection by two spherical planes. | 3 | 3 | Refraction of light | 1 |
| | | | | 4 | Angle of Minimum Deviation | 1 |
| | | | | 5 | Refraction of spherical surface | 1 |
| | 3 | Lens<br>The properties of images in Lenses<br>The question of lens<br>The focal length of lenses | 7 | 6 | Type of lenses | 1 |
| | | | | 7 | How lens works | 1 |
| | | | | 8 | Lens image properties | 1 |
| | | | | 9 | The equation of lens maker | 1 |
| | | | | 10 | Measure the focal length of concave lens | 1 |
| | | | | 11 | Measure the focal length of convex lens | 1 |
| | | | | 12 | Eye defects | 1 |
| Chapter 10 | 1 | Simple Harmonic Motion | 2 | 1 | Simple Harmonic Motion in spring | 1 |
| | | | | 2 | Simple Harmonic Motion in simple Pendulum | 1 |
| | 2 | Wave motion | 1 | 3 | Wave motion | 1 |
| | 3 | Types of Waves | 1 | 4 | Types of Waves | 1 |
| | 4 | Properties of Waves | 2 | 5 | Properties of Waves (Reflection, refraction) | 1 |
| | | | | 6 | Properties of waves “interference” | 1 |
| | 5 | Standing Waves | 1 | 7 | Standing Waves | 1 |
| | 6 | Interference of Light | 1 | 8 | Interference of Light | 1 |
| | 7 | Diffraction of waves | 1 | 9 | Diffraction of waves | 1 |
| | 8 | Diffraction of Light & waves | 1 | 10 | Diffraction of Light & waves | 1 |
| | 9 | Polarization of light (Polarized wave) | 1 | 11 | Polarization of light (Polarized wave) | 1 |
| | 10 | Polarization of light by reflection | 1 | 12 | Polarization of light by reflection | 1 |

### 3.2.3 Tasks of Course Design

1) Specification of Course (Lesson)

This task defines the overview of the Lesson, objectives and teaching method of the Lesson.

2) Lesson Plan*

A Teacher usually makes a lesson plan for an ordinary lesson. This lesson plan is similar to the ordinary lesson plan. It contains an outline of a story with time, contents, activities, questions and evaluation.

* The teachers usually make lesson plans for ordinal lessons. A lesson plan of a digital material is similar to these, it designs story, material and instruction of lessons.

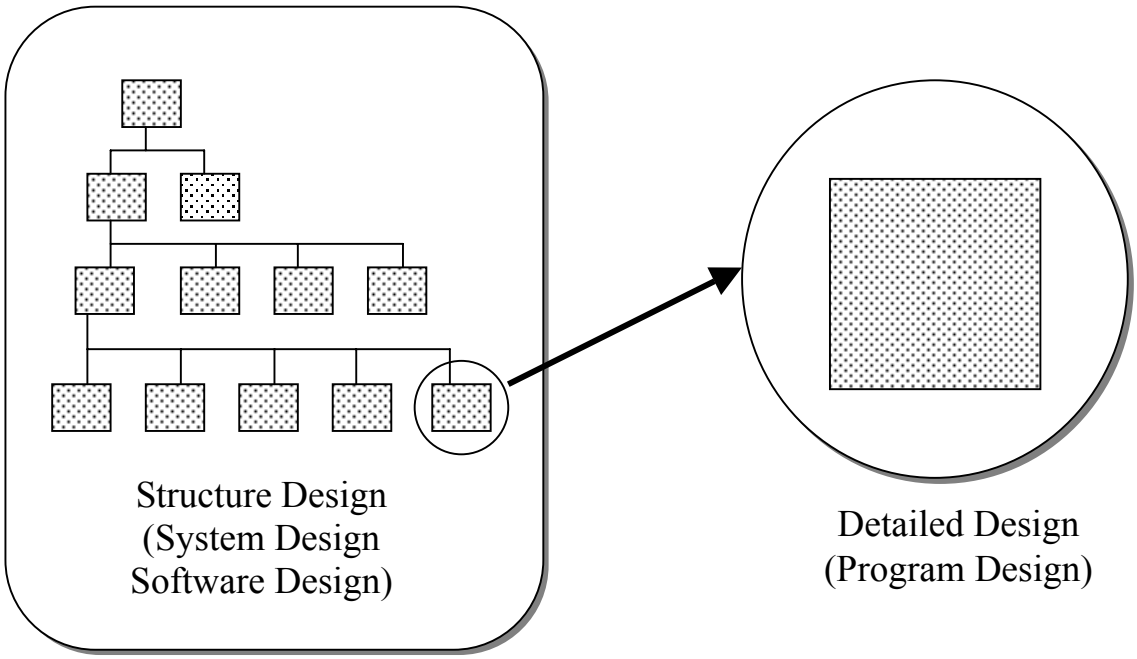
3) Design of Supplementary Items

This is the design of hints, glossaries, and exercises for fast-learners.

4) Structure of Lesson

The design method the team took was based on the structured design. At first, the structure of modules that are components of the digital material were designed, and then details of modules were designed.

**Figure 3.2.1 Structured Design Method**




### 3.2.4 Output of Course Design

Table 3.2.3 illustrates output of Detailed Design.

**Table 3.2.3 Output of Course Design**

| Form name | Pages |
|---|---|
| Specification of Lesson | 24 |
| Lesson Plan | 24 |
| Lesson Level Cluster | 24 |

## 3.3 Detailed Design

### 3.3.1 Scope of Work

Based on the basic and course designs, this task involved the design of specific elements of each component. The outputs are the following:

1) Screen design and text scenario
2) Images of the graphics, movies, animations and simulations
3) Sound scenario and images of music

4) Glossaries of exercises and practices
5) Specifications of operation and movement of each program

### 3.3.2 Tasks of Detailed Design

This project developed the digital material both in English and in Arabic. The counterpart members designed in Arabic, then a translator made it into an English document. The JICA team reviewed the output in order to improve the detailed design.
Detailed design used the following form (Table 3.3.1).

**Table 3.3.1 Detailed Design Form**

| Form name | File name | Definition |
|---|---|---|
| Screen | D_screen.doc | Define text, graphic, movie, animation, simulation, question. |
| Story board | CD_storyboard.doc | Movement of contents (movie, animation, simulation) |
| Time Line | D_timeline.doc | Sequence of materials |
| Narration | D_narration.doc | Narration |
| Glossary | D_glossary.doc | Glossary |
| Reference List | D_reference list.doc | Reference |

### 3.3.3 Review

The JICA team reviewed the output of the Detailed Design and found a number of points requiring improvement. Typical review comments were the following.

1) There is almost no interaction with the students in the materials, which include only animations and the presentations. Add interactive content of at least ten minutes.
2) Some screen design defines text only. Do not design a screen of only text. Consider a figure or a picture, which helps understanding.
3) Some designs have many questions in one screen. Divide questions into each page. Remember the method in HTML to describe the definition of the problem.
4) Put a hint within a question screen. (It is a correspondence to the student who does not understand) A figure may be put on the question. Or, when a hint is pushed, it is one method to make a figure come out.
5) Do not display too many characters (text) on a screen.
6) Add simulation and a movie, which maintains students' interest.
7) There are many animations. Some of them may be changed into simulations.
8) Add the element of fun, like games, cartoons, various answer forms.
9) Change the learning sequence. Try the Question- first mode.
10) Discuss maintaining and improving a student's motivation.
11) Learning physics is not just memorizing mathematical formulae. Give students ideas of physical phenomena and physics thinking.
12) Don't use the virtual material or movie too much. Use real-world movies and try to include a

real-experiment.

13) If a concept is too difficult to study for students, better to divide it into appropriate smaller concepts.

### 3.3.4 Output of Detailed Design

Table 3.3.2 illustrates output of Detailed Design.

**Table 3.3.2 Output of Detailed Design**

| Chapter | ID | Title | Page (English) | Page (Arabic) |
|---|---|---|---|---|
| Chapter 9 | OPM-01 | Reflection Absorption of Light | 37 | 36 |
| | OPM-02 | Transmission of Light | 37 | 36 |
| | OPM-03 | Refraction of Light | 37 | 36 |
| | OPM-04 | Angle of Minimum Deviation | 46 | 45 |
| | OPM-05 | Refraction of Spherical Surface | 34 | 33 |
| | OPM-06 | Type of Lenses | 37 | 36 |
| | OPM-07 | How Lens Works | 30 | 29 |
| | OPM-08 | Lens Image Properties | 49 | 48 |
| | OPM-09 | The Equation of Lens Maker | 36 | 35 |
| | OPM-10 | Measure the Focal Length of Concave Lens | 31 | 26 |
| | OPM-11 | Measure the Focal Length of Convex Lens | 28 | 26 |
| Chapter 10 | OPM-12 | Eye Defects | 41 | 40 |
| | OMW-01 | Simple Harmonic Motion in Spring | 43 | 42 |
| | OMW-02 | Simple Harmonic Motion in Simple Pendulum | 34 | 33 |
| | OMW-03 | Wave Motion | 23 | 25 |
| | OMW-04 | Types of Waves | 43 | 42 |
| | OMW-05 | Properties of Waves (Reflection, Refraction) | 36 | 35 |
| | OMW-06 | Properties of Waves “interference” | 38 | 37 |
| | OMW-07 | Standing Waves | 35 | 34 |
| | OMW-08 | Interference of Light | 36 | 35 |
| | OMW-09 | Diffraction of Waves | 28 | 27 |
| | OMW-10 | Diffraction of Light & Waves | 38 | 26 |
| | OMW-11 | Polarization of Light (Polarized Wave) | 31 | 29 |
| | OMW-12 | Polarization of Light by Reflection | 35 | 33 |

# 4

# TENDER PROCESS

## 4.1 Tender Documents for Self-Learning Teaching Materials Development

### 4.1.1 Object of Tender

The JICA Study Team executed a tender for digital self-learning contents development. The Schedule of the process is shown below.

| Tender Procedure | Date |
|---|---|
| Draft version of tender document was drawn up | 10th July 2002 |
| Discussion with counterpart, JICA (Jordan), JICA (Japan) | 11th – 23rd July 2002 |
| Finalization of the document | 23rd July 2002 |
| Notice to expected bidders | 23rd July 2002 |
| Collection of the document by bidders (tender issue) | 25th July 2002 |
| Closing date and time | 11th Aug, 2002 at 2:00 pm |
| Prototype demonstration by bidders | 12th Aug, - 14th Aug, 2002, 9:00 am - 3:00 pm |
| Evaluation | 20th of Aug, 2002 |
| Contract awarding | 26th of Aug, 2002 |

### 4.1.2 Composition of Tender Document

The tender document was composed of the following parts.

1) Request for Proposal "Digital Self-Learning Material Development"
2) Attachment 1 "List of Equipment Supplied By the JICA Study Team"
3) Attachment 2 "Digital Self-Learning Material Specification"
4) Attachment 3 "Detail Specifications for Lesson 8 in Chapter 9 and Lesson 8 in Chapter 10"
5) Attachment 4 "Parts of Textbook Relevant to Lesson 8 in Chapter 9 and Lesson 8 in Chapter 10"
6) Attachment 5 "List of Analyzed Items in Textbook Analysis"

## 4.2 Evaluation for Self-Learning Teaching Materials Development

### 4.2.1 Evaluation Items

1) Prototype Demonstration

Bidders were given two weeks for designing a prototype material for Lesson 8 Chapter 9 or Lesson 8 Chapter 10. Each of the bidders was invited to do a demonstration of the prototype in front of the evaluation committee from 12th to 14th August 2002. Individual committee members separately gave

scores to the quality and degree of compliance with the requirements specified in the design documents included in the tender document. An evaluation sheet with 21 separate evaluation items was developed and utilized in prototype demonstration.

2) Company Qualifications

In this tender, the following items were evaluated as information for the company qualifications.

- Capital
- Date of Establishment
- Name of President
- Office Location(s)
- Financial Status in last 3 years
- Number of Employees
- Staff of Information Technology Division
- Staff of e-Learning Division, who are classified into the following without overlap

* Staff with certification relevant to information technology
* Summary of staff education level

3) Experience

Bidders were evaluated on the strength of references from clients for which the bidder has completed at least a project of similar scope and nature. Required Information included a description of the project, company name, address, telephone and fax number, and contact person, in the form shown below:

- Experience in the area of information technology
- Experience in the area of e-learning
- Experience with the Ministry of Education in the area of information technology
- Explanation of a sample or samples
- Facilities relevant to movie, animation and picture
- Facilities relevant to music and sound

4) Project Organization

Bidders were evaluated on the relevance of information on the proposed project organization and staff members. Information included:

- Project Organization
- List of Project Staff, in which the role and working place of each staff shall be specified.
- Resumes of each staff
- Project schedule
- Manpower and cost estimation classified in the project activities
- List of deliverables, which shall be specified as paper or electronic data
- Methodology of progress control and quality management

5) Price

Prices offered by each of the bidders were also evaluated for their reasonableness.

### 4.2.2 Evaluation Procedure

After receiving the proposals and observing the prototype demonstrations, individual Evaluation Committee members were given four days to complete evaluation sheets. Completed sheets were collected and average scores across members by item were calculated as well as averages by item groups such as prototype demonstration, company information, organization and method of carrying out this project, and experience in similar projects. Numbers in each of the cells are the average of several score points given by each evaluator.

An Evaluation Committee meeting was held on 20th August. Discussion was made to ensure the reasonableness of each average figure. The committee also determined weights assigned to each item groups. Then the weighted sum of the average scores was calculated for each bidder. The bidders were then ranked by the resulting sum of average scores.

Cost proposals were then examined for their reasonableness. In this Study, cost was considered secondary. The contract negotiation would start by the end of the third week of August 2002. If the negotiation with the top ranked company failed, the Study Team would switch the negotiation partner to the second ranked company.
As a result of this procedure, Menhaj was chosen and the contract was signed by the end of August 2002.

## 4.3 Tender for Equipment

The TOR of this Study stipulates that adequate equipment necessary for developing digitized self-learning materials be available to the Study Team, counterpart task force members as well as the staff of the contractor who are expected to work side by side with task force members. Acquisition of necessary equipment therefore should be done before the start of actual work of producing digitized self-learning materials. A tender was held in July 2002 for the supply of equipment. The tender was successfully completed and a local supplier was selected. The equipment was delivered in full by the end of August 2002.

## 4.4 Tender Documents for Evaluation and Analysis of Self-Learning Teaching Material Development

The JICA Study Team also executed a tender of Evaluation and Analysis of Self-Learning Teaching Material Development. One local company in Jordan was selected as the Investigator and the Investigator evaluated and analyzed i) effect on students i.e. learning effect and effect on attitude, ii) digital material itself, and iii) learning time of each page, correct ratio of each question before (pre-trial), during (in-trial), and after (post-trial) the introduction of self-learning material into the 4 pilot schools (2 boy's-schools and 2 girl's-schools).

# 5

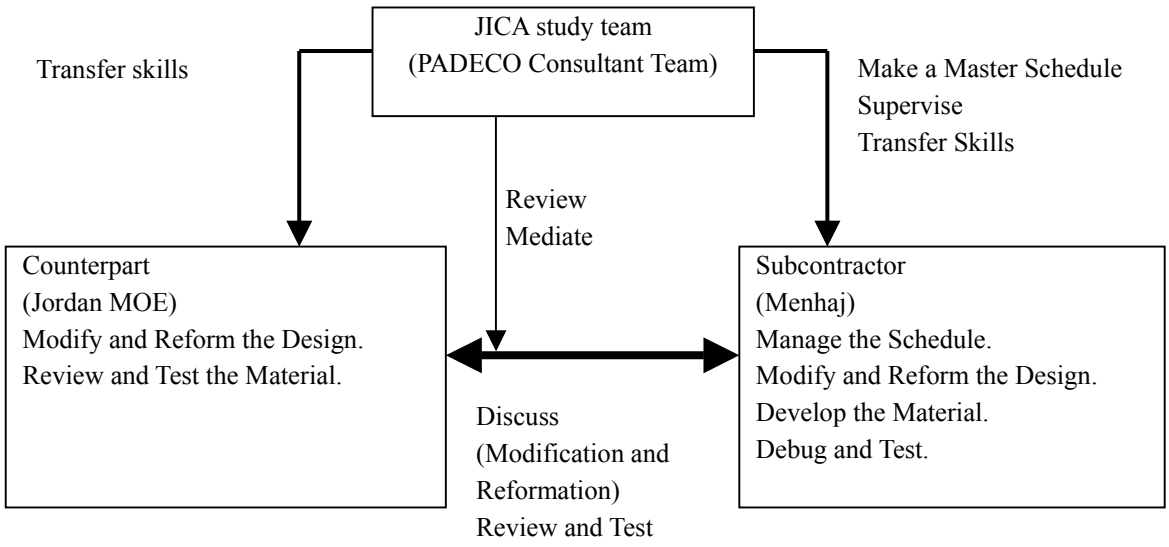
# DEVELOPMENT OF DIGITAL SELF-LEARNING MATERIALS

## 5.1 Organizational Structure and Development Process

### 5.1.1 Organizational Structure and Responsibilities

1) Overview of Organization

**Figure 5.1.1 Overview of Organization Structure Chart**




Following the design phase, the Counterpart and the Subcontractor carried out the development of the digital material by cooperation. The roles in the development phase are the following.

a) The Role of Counterpart:

- Review and revise the detailed design with the staff of the Subcontractor;
- Review and check the actual digital materials;
  (including ideas of modification and reformation)
- Detect and debug errors, such as mistakes in text and narration;
- Prepare the experiment necessary for movies;
- Carry out the final acceptance test;

b) Subcontractor:

- Manage the development (schedule, quality and organizational management)
- Review and revise the detailed design with the Counterpart;
- Develop the material such as graphics and programs;

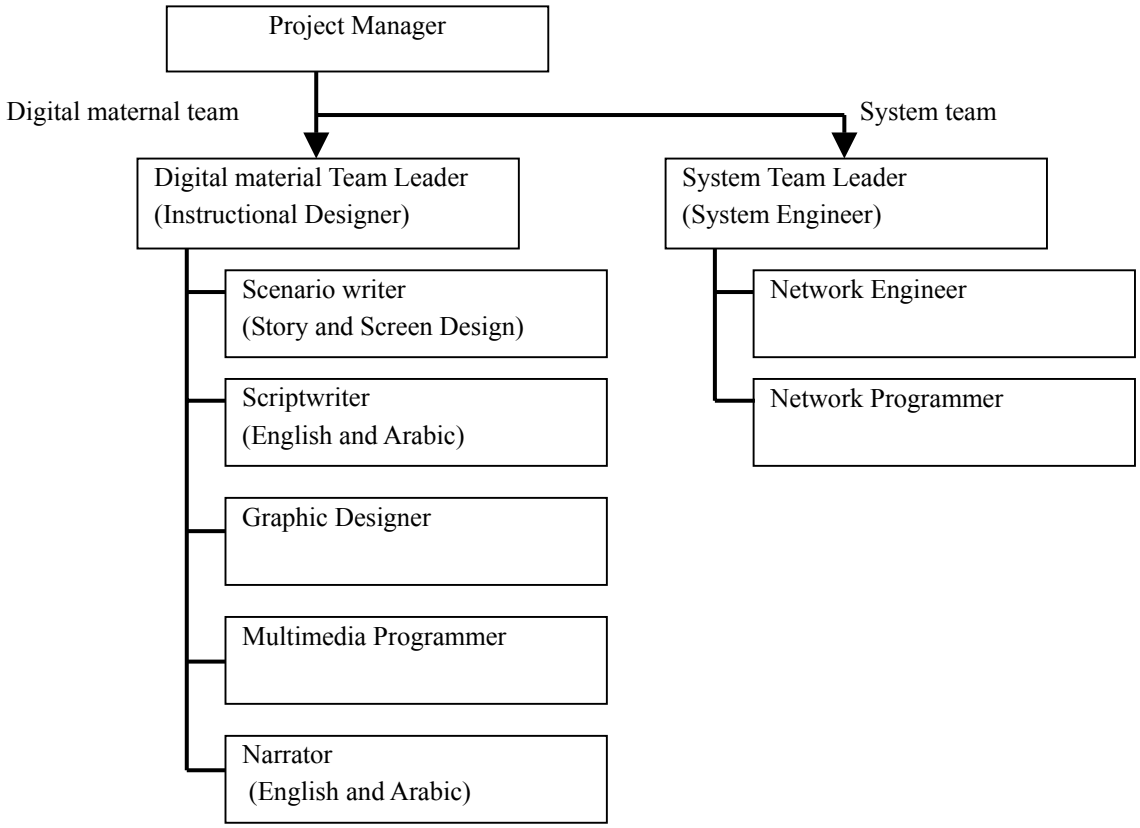
- Design and develop systems such as the Log-in system, Logging system and BBS;
- Debug and test programs and systems;
- Modify and reform the digital material to correspond with the results of the review;

c) JICA (PADECO consultant team):

- Give technical support to the Counterpart and Subcontractor;
- Give suggestions on modification and reformation;
- Make a master schedule and supervise operations;
- Mediate between the Counterpart and Subcontractor.

2) Organization Chart of Subcontractor

**Figure 5.1.2 Organization Chart of Subcontractor (Menhaj)**



### 5.1.2 Development Management Process

1) Schedule

a) Planed schedule

| | August | September | October | November | December | January | February | March |
|---|---|---|---|---|---|---|---|---|
| Development of digital teaching materials. | | | | | | | | |
| Quality check(Acceptance test) | | | | | | | | |

b) Actual schedule including details

| | August | September | October | November | December | January | February | March |
|---|---|---|---|---|---|---|---|---|
| Development of digital teaching materials. | | | | | | | | |
| Review of the Basic design | | | | | | | | |
| Development of Draft (Chapter 9) | | | | | | | | |
| Development of Draft (Chapter 10) | | | | | | | | |
| Modification and Reformation(Chapter9) | | | | | | | | |
| Modification and Reformation(Chapter10) | | | | | | | | |
| Final Debug(Chapter9) | | | | | | | | |
| Final Debug(Chapter10) | | | | | | | | |
| Quality check(Acceptance test) | | | | | | | | |
| Preparation of Acceptance test | | | | | | | | |
| Acceptance test | | | | | | | | |

In comparison with the first detailed design finished in July, the final development output i.e., digital material, was excellent in quality and quantity. The development actually took a further 2 months than planned, but the JICA Study Team afforded this delay. Indeed, the delay did not hinder the trial. The reasons of the delay were due to i) reviewing and revising the first detailed design, ii) modification and reformation of the draft version, iii) careful debugging of details such as text, narration.

2) Development Procedure and Tasks

The development phase consisted of the following sub-phases.

a) Review of Basic Design

First the JICA Study Team including PADECO's consultant team, counterpart and subcontractor, Menhaj, reviewed and discussed the basic design. More specifically, they checked the following issues:

- Standard style of digital material (Screen, color and font type)
- Standard of Quiz and Question on digital materials

Regarding the system function, the PADECO consultant team and Menhaj discussed and determined the file layout, the user interface and implementation of the system.

b) Development of Draft Design Document

Before development of graphics and programs, the JICA Study Team reviewed and revised the first detailed design documents. The team held a one or two day meeting for each lesson to discuss; i) overall lesson, ii) story of the lesson, iii) simulations and animations and iv) quiz and questions. In this meeting the Counterpart suggested ideas based on their valuable experience as teachers or supervisors, especially for pedagogical issues, while Menhaj gave educational- technical ideas based on their instructional design skills and knowledge.

During the development, the Counterpart stayed in the Menhaj office and checked the tentative output from the designer and programmer. The Counterpart and members of Menhaj engaged in productive communication to improve the digital materials; they modified the design documents repeatedly with patience.

c) Modification and Reformation

After the Draft version was developed, the Counterpart and Menhaj carried out a large modification and improvement. These were i) improvement of common screen operation.ii) modification and reformation of simulations and animations, iii) addition of many more movies and iv) improvement of the teacher menu, that is the list of the learning objects.

d) Final Debug

To maintain good quality, the Counterpart checked simple errors such as wrong spelling or wrong expressions in Physics.

3) Quality Management

This Project accomplished development of digital materials with high quality. From the viewpoint of management, the JICA Study Team took the following steps to ensure high quality.

- Reviewing and revising the first detailed design;
- Reviewing documents (Maintenance of detailed design documents and using screen-printed documents);
- Mutual communication between the Counterpart and Subcontractor;
- Development of a draft version;
- Final debug phase.

4) Schedule Management

The PADECO consultant team made a master schedule, and the Subcontractor: Menhaj then planned detailed schedule considering human resources. The JICA Study Team regularly followed the progress of development, and the team sometimes solved problems and changed the schedule. In order to facilitate this, the team held a weekly progress meeting.

5) Organization Management

As a result of the increasing number of tasks and changes in the schedule, the following action was taken.

For Counterpart:

The Counterpart stayed in the office of Menhaj to concentrate on the process of reviewing and designing and to facilitate easier communication between programmers and designers.

For Mehnaj:

For a short time, Menhaj added 4 programmers to the original 2 programmers. Menhaj also employed another native English speaker for narration.

## 5.2 Acceptance Testing

### 5.2.1 Overview of Acceptance Testing

1) Overview of Acceptance Test

The Acceptance Test was planned to be executed from 5th January 2003 till 20th January 2003. In this period, JICA Study Team confirmed that the self-learning material was developed according to all specifications and requirements of the JICA Study Team. If any item of the Acceptance Test was not satisfied within the specifications and requirements the Developer (Menhaj Technologies) was required to correct them in this period.

### 5.2.2 Procedure

1) The staff of the contractor (Menhaj Technologies) arranged the environment for acceptance testing.
2) The inspector of the JICA Study Team and staff of the contractor executed this acceptance testing in cooperation with each other.
3) If the result of a test item was successful, the inspector wrote his signature in the Acceptance the Test document.
4) If the result of a test item was not successful, the inspector and staff discussed and made countermeasures, (bug fix or new solution) and then executed the test again.

### 5.2.3 Results of Acceptance Testing

The Acceptance Test has detected 15 simple errors. After acceptance testing, the Subcontractor accomplished all necessary corrections.

# 6

# TRIAL INTRODUCTION OF THE MATERIALS

## 6.1 Selection of Pilot Schools

### 6.1.1 School Conditions

The Task Force Team defined the following conditions for potential pilot schools.

- Location: 2 schools in Amman, 2 schools in a local city.
- Gender: 2 boys-schools and 2 girls-schools.
- Number of students: each school must have at least 3 classes in Grade 11 (20-40 students / class).
- PC and Connectivity: each school must have good Internet connection and more than 20 PCs in a PC lab.

### 6.1.2 Selected Pilot Schools

The JICA Study Team asked the Directorate of Curricula and School Textbooks to select schools that fit the conditions above and the Directorate selected them by the end of January 2003 (see Table 6.1.1).

**Table 6.1.1 Selected Schools**

| School Name | Gender | Location | Subject (Students) | PCs |
|---|---|---|---|---|
| Omar Bin El-Khatab | Boy | Amman | 135 | 20 |
| Irbid Secondary | Boy | Irbit | 67 | 40 |
| Al Jaloot | Girl | Amman | 123 | 20 |
| Noor Al-Hussein | Girl | Irbit | 105 | 20 |

In order to assure an equal level among schools, the JICA Study Team decided to select the schools with similar scores based on student performance.

## 6.2 Implementation of Trials

During school selection, the JICA Study Team started preparing the trials. They had to consider the long holiday 'Eid Al Adha' in the beginning of February. First, the JICA Study Team visited each school and had meetings with the principal, Physics teacher, and IT teacher and explained about: i) purpose of the trial, ii) preparation of the trial, iii) task and schedule of the trial.
Then, they requested school profile.

### 6.2.1 Preparation of Teacher Training

The Counterpart and Menhaj mainly prepared Teacher training. Because it was difficult to conduct the teacher training in each school, and there was no time to do so, the JICA Study Team held one teacher

training session in Al Jaloot in Amman and all the teachers came and took the training.

### 6.2.2 Preparation of Student's Workbook

The Counterpart made a student's workbook with the following features.

- It contains some activities for students who finish studying earlier than average students.
- It has about 24 pages (One page for one lesson)
- It is printed for the trial and provided to students. For the purpose of using it for teachers and students after the trial, the digital materials were made as pdf.file. (see CD student workbook).

### 6.2.3 Implementation of the Digital Material

First, the JICA Study Team installed the digital materials into Omar Bin El-Khatab schools and tested them. Then, the team installed them into the other three schools. The problems encountered were the following:

- The digital material needed flash player, but it was not installed in the PCs. The team had to obtain it as a free license for education from Macromedia Co.
- Some headsets were out of order, and the schools purchased new ones by the beginning of trial.

### 6.2.4 Preparation of Baseline Survey

The JICA Study Team made: i) a Pre-Test and Pre-Questionnaire to establish the Baseline situation, ii) In-Trial Questionnaire for In-Trial, and iii) Post-Test and Post-Questionnaire for after Trial. (see the details in 6.4 Baseline Survey)

All the trial schools applied the Pre-Test and Pre-Questionnaire on 16th of February. Counterparts went to each school and conducted the survey.

### 6.2.5 Teacher Training

The teacher training was held from 4$^{th}$ to 5$^{th}$ of February. (see the details in 6.3.2 Teacher Training)

### 6.2.6 Student Training

Before using the digital material in the lesson, the JICA Study Team held trainings for students in each school on 17th or 18th of February. The purpose of this training was to accustom students with the operation of the materials and for schools to have final conformation of the trial environment. The program was the following:

| | |
|---|---|
| How to log on to the system | How to operate the digital materials |
| How to use BBS | How to surf the Internet |

Noor Al-Hussein School applied a useful method for logging in; it delivered a small paper containing the appropriate ID and password to each student. The Team suggested other schools to follow the same procedure.

**Table 6.2.2 Schedule for Implementation of Trial**

Schedule : Preparation of trials & installation　　create 20/Jan/2003/ Go ota
○ School holiday ● Holiday　　Plan - - -　Fix ———

| | | Holiday | for All schools | | | for each school | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Training Preparation | System test Installation | Task | Al Jaloot Girls,Amman | Omar Bin El-Khatab Boys,Amman | Irbid Secondary Boys,Irbid | Noor Al-Hussein Girls,Irbid |
| 19-Jan | Sun | ○ | | | | | | | |
| 20-Jan | Mon | ○ | | | | | | | |
| 21-Jan | Thu | ○ | | | | | | | |
| 22-Jan | Wed | ○ | | | | | | | |
| 23-Jan | Thu | ○ | | System Test ↑ ○ | | | Visit ↕ | | |
| 24-Jan | Fri | ● | | Omar Bin El-Khatab | | | | | |
| 25-Jan | Sat | ● | | | | | | | |
| 26-Jan | Sun | ○ | Visit Amman ↑ | ○ | | Visit ↕ | | | |
| 27-Jan | Mon | ○ | Visit Irbid ↓ | ○ | | | | Visit ↕ | Visit ↕ |
| 28-Jan | Thu | ○ | | | | | | | |
| 29-Jan | Wed | ○ | | | ▲Test | | | | |
| 30-Jan | Thu | ● | | | ▲Training material | | | | |
| 31-Jan | Fri | ● | | | | | | | |
| 1-Feb | Sat | ● | | | ▲Contents | | | | |
| 2-Feb | Sun | | 2nd semester | Installation ↑ | ▲Hand book | Installation ↕ | Installation ↕ | | |
| 3-Feb | Mon | | Training ↑ ○ | | | | | | |
| 4-Feb | Thu | | Omar Bin El-Khatab | | | Teacher Training | | | |
| 5-Feb | Wed | | ↓ | | | ↓ | | Installation ↕ | Installation ↕ |
| 6-Feb | Thu | | | | | | | | |
| 7-Feb | Fri | ● | | | | | | | |
| 8-Feb | Sat | ● | | | | | | | |
| 9-Feb | Sun | | | | | | | | |
| 10-Feb | Mon | ? | | | | | | | |
| 11-Feb | Thu | ● | | | | | | | |
| 12-Feb | Wed | ● | | | | | | | |
| 13-Feb | Thu | ● | | | | | | | |
| 14-Feb | Fri | ● | | | | | | | |
| 15-Feb | Sat | ● | | | | | | | |
| 16-Feb | Sun | | Start of trials | | | Pre-test&Quest | Pre-test&Quest | Pre-test&Quest | Pre-test&Quest |
| 17-Feb | Mon | | | | | Student training | | | |
| 18-Feb | Thu | | | | | | Student training | Student training | Student training |

## 6.3 Teacher Training

### 6.3.1 Manual Development

Teacher Training manuals are for both Physics teachers and IT teachers and were designed as to understand i) the purpose of the development of digital materials, ii) the operation of the digital materials and iii) management of the system.

Table 6.3.1 shows the index of text.

**Table 6.3.1 Content of Teacher Training Manual**

| | |
|---|---|
| Program Objectives: | |
| Introduction: | |
| How to Use: | About the course: |
| | Teacher's menu: |
| | Collaboration Tools (BBS) |
| | Glossary |
| | The lessons: |
| The programs advantages for both teachers and students: | |

1) Summary of Training

- Training Date
  Day one: Monday, February 3rd, 2003
  Day two: Tuesday, February 4th, 2003
  10am – 13:30pm

- Training Place
  Ain Jalout Al-Shamelah School for Girls and Menhaj

- Participants
  One Physics teacher and one IT teacher in each school.

- Training Program

| Date | Session | Participants | Place | Trainer | Summary of Program |
|---|---|---|---|---|---|
| 3/Feb | 1st Session | Physics, IT | Ain Jalout | CP and Menhaj | Introduction |
| | 2nd Session | Physics, IT | Ain Jalout | Menhaj | How to operate the material. |
| 4/Feb | 1st Session | Physics | Ain Jalout | Menhaj | How to use the material. |
| | 2nd Session | Physics | Ain Jalout | CP | How to do lesson pedagogically. |
| | 2nd Session | IT | Menhaj | Menhaj | System management |

## 6.4 Baseline Survey

### 6.4.1 Preparation of Test and Questionnaire

For the Baseline Survey, the Task force team made a Pre-Test, Pre-Questionnaire, In-Trial-Questionnaire, Post – Test, Post-Questionnaire (see Table 6.4.1).

**Table 6.4.1 Survey Test and Questionnaires**

| Term | Type | Comment |
|---|---|---|
| Pre | Questionnaire | Attitude and experience |
| | Test | Chapter 9 |
| Trial | Questionnaire | Impression for lessons |
| Post | Questionnaire | Attitude and experience |
| | Questionnaire | Impression for lessons |
| | Test | Chapter 9 and 10 |

1) Test Structure

Both pre-test and post-test were designed to have the same level of difficulty.

- Pre-test
  - Target: Chapter 9
  - Questions: 10 question (20 minutes)
    1) Linguistic knowledge-Terms or definition (5 Questions)
    2) Skill to apply - Intelligent skill - Calculate or solve the problem (5 Questions)
  - Methods of testing: to choose 1 answer from 4 multiple choices
  - Expected average score: about 60/100 and expected SD (Standard Division), is about 10

- Post-test
  - Target: Chapter 9 and 10
  - Questions: 20 question (40 minutes)
    1) Linguistic knowledge-Terms or definition (10 Questions)
    2) Skill to apply - Intelligent skill –Calculate or solve the problem (10 Questions)
  - Methods of testing: to choose 1 answer from 4 multiple choices
  - Expected average score: same as pre-test

2) Questionnaire

- Pre-questionnaire
  - Questions: 18 questions (20 minutes)
    1) Experience about IT (Question 1-4)
    2) Attitude and learning style
       Interest in Media and IT (Question 5 - 8)

Interest in Physics and Science (Question 9 - 12)
3) Learning style (Question 13-18)

- Methods of testing: Semantic deference method and filling in blanks.

- In trial – questionnaire
  - Questions: 10 questions (5 minutes: after each lesson, students take this questionnaire as for impression of each lesson)
    1) Attention (Question 1-2)
    2) Relevance (Question 2-5)
    3) Confidence (Question 6-8)
    4) Satisfaction (Question 9-10)
  - Methods of testing: Semantic deference method and filling in blanks.

- Post - questionnaire
  - Questions: 10 questions (20 minutes: after each lesson, students take this questionnaire for an impression of each lesson)
    1) Attitude and learning style
    Interest of Media and IT (Question 1 - 3),
    Interest of Physics and Science (Question 4 - 6)
    General impression of e-learning (Question 7- 10)
    Impression for all lessons (this digital material)
    1) Attention (Question 11-12)
    2) Relevance (Question 13-15)
    3) Confidence (Question 16-18)
    4) Satisfaction (Question 19-20)
  - Methods of testing: Semantic deference method and filling in blanks.[2]

There are few theories or models that have an obvious method of measurement. Some researchers use the ARCS (Attention, Relevance, Confidence, and Satisfaction) model.

3) Log Data

Logging data is automatically recorded in the Server PC in each school. The following information can be collected from the logged data.

- Learning sequence
  Which pages does a student use?
  How does the student navigate in a lesson?
- Learning time
  How long does a student use each page?
  (Total learning time of each lesson can be calculated from each page's time)
- Result of questions
  Does the student make a correct answer or not?

[2] Questions of Impression for digital material are designed to follow ARCS Model (Keller, 1983).

What is the student's wrong answer?
(Total score of each lesson can be calculated from the result of each question)

### 6.4.2 Execution of Test and Questionnaire

Physics teachers have a responsibility to apply tests and questionnaires in each school. When tests and questionnaires were implemented, the Counterpart went to schools and helped Physics teachers. Table 6.4.2 shows the schedule of Tests and Questionnaires.

**Table 6.4.2 Schedule of Test and Questionnaire**

| Term | Type | Date |
|---|---|---|
| Pre | Questionnaire | 16th/Feburay (All schools) |
| | Test | |
| Trial | Questionnaire | After each lesson, student answers the In-trial Questionnaire. |
| Post | Questionnaire | 24th/April (All schools) |
| | Test | |

# 7

# EVALUATION OF DIGITAL SELF-LEARNING MATERIALS

## 7.1 Evaluation Method

### 7.1.1 Objectives

This chapter summarizes the collection of data, analysis and evaluation for the project to develop the self-learning digital materials for Physics Grade 11 (24 hours).
The evaluation goal was to research the following points;

1) Student‘s learning performance
   - Can the self-learning digital materials improve students learning performance?
   - What is a difference between self – learning digital material and ordinary lesson?

2) Student’s attitude
   - Can the self-learning digital materials improve and change students’ attitude?
   - What is the interaction and relationship between digital material and students’ attitude?

3) Evaluation of the digital material itself
   - What kind of digital materials are good for students?
   - Are the self-learning materials that this project developed appropriate for students?

### 7.1.2 Summary of Experimental Conditions

1) Basic Experimental condition

Students are divided into 3 experimental groups by Factor ‘Teaching method’ (see Table 7.1.1 and 7.1.2).

**Table 7.1.1 Experimental Groups of the Trial**

| Group | Condition (Teaching Method) | Group ID |
|---|---|---|
| Experimental group1 | Self- learning with Digital material | **E1** |
| Experimental group2 | Ordinary lesson with Digital material | **E2** |
| Control group | Ordinary lesson | **Cont** |

Three groups have 24 Lessons (45min/lessen) in 2 months.

- Experimental Group1 (**E1**): Students use self-learning digital material without lecture.
- Experimental Group2 (**E2**): Teacher gives lecture with using digital material. Teacher uses a projector to show animations, simulations and movies to students.
- Control Group (**Cont**): Teacher gives ordinary lecture.

Subject:
3 classes in Grade 11 in 4 schools. 20-40 students / class.

**Table 7.1.2 Subject of the Trial**

| | Group ID | Girls school 1 | Boys school 1 | Girls school 2 | Boys school 2 |
|---|---|---|---|---|---|
| Group1 | **E1** | 18 | 39 | 20 | 19 |
| Group2 | **E2** | 45 | 34 | 20 | 35 |
| Control | **Cont** | 27 | 33 | 20 | 35 |
| Total | | 90 | 106 | 60 | 79 |

Note: Because each school has 20 or 40 PCs, the Number of students in group1 is almost either 20 or 40.

2) Measurement of Test Data

Table 7.1.3 shows the measurement of data in this experiment.
For student:

Pre-test and Post test
Pre-Questionnaire, In-trial-Questionnaire and Post -Questionnaire

For digital material

Logging data (page-access, response of question)
The self-learning system outputs these data automatically.

**Table 7.1.3 Measurement of Test Data**

| Term | Type | Comment | Subject |
|---|---|---|---|
| Pre | Questionnaire | Attitude and experience | E1, E2, Cont |
| | Test | Chapter 9 | E1, E2, Cont |
| Trial | Questionnaire | Impression for lessons | E1 |
| Post | Questionnaire | Attitude and experience | E1 |
| | Questionnaire | Impression for lessons | E1 |
| | Test | Chapter 9 and 10 | E1, E2, Cont |

### 7.1.3 Analysis and Evaluation

1) Overview of Analysis and Evaluation

Basic statistics (Average, SD for all and each school[3]*1, Students) were calculated using statistical techniques with PC software (SPSS).
Covariate: T- test: Correlation:

The evaluation is classified into three categories (see Table 7.1.4).

[3] Because the students' level among schools is not guaranteed to be equivalent, each school has been analyzed to make total data.

**Table 7.1.4 Classification of Evaluation**

| Classification | Measurement | Factor |
|---|---|---|
| Effect of self-learning materials | Test score<br>Attitude score | Lesson methods<br>Attitude |
| Relationship between students' attitude and self-learning materials | Test score<br>Attitude score | Lesson methods<br>Attitude |
| Evaluation for self- leaning materials | Test score<br>Impression | Contents themselves |

## 7.2 Evaluation Results

### 7.2.1 Baseline

Before Trial, the project surveyed some feature of students. Pre-Test and Pre-Questionnaire indicate following results.

1) Subjects (Students)

The Trial assessed 345 subjects within 2 boy's schools and 2 girl's schools. Table 7.2.1 display the composition of the subjects.

**Table 7.2.1 Number of Subjects**

| Group | Girl1 | Girl2 | Boy1 | Boy2 | Total |
|---|---|---|---|---|---|
| E1 | 18 | 20 | 39 | 18 | 95 |
| E2 | 45 | 20 | 34 | 35 | 134 |
| Cont | 27 | 20 | 33 | 36 | 116 |
| Total | 90 | 60 | 106 | 89 | 345 |

2) Student's experience about IT

The Pre-Questionnaire has the following three questions related to student's experience in IT.

Q1) Approximately how often do you use a computer?
Almost every day. 1-3 times per week 1-3 times per month Less than once a month Not at all

Q2) When you use a computer, where do you use it? (Check all that apply)
Home School Internet Cafe others

Q3) When you use a computer, what kind of software do you often use? (Check all that apply)
Word processor mail browser spreadsheet game learning material others

Table 7.2.4 and Figure 7.2.1, 7.2.2, and 7.2.3 are the results of Q1, Q2 and Q3 of the Pre - Questionnaire. These data show the following students' behavior in IT. (This result only reflects the situation of students in the four trial schools) Pre-Questionnaire has following three questions related to student's experience about IT.

- Half of the students use the PC every day, and 40% of all the students use the PC 1-3 times a week. This means 90% of the students have an opportunity to use a PC at least once a week. It assumes that this opportunity includes the Subject `IT' lesson in school.
- 70% of the students can use a PC at home and 40% can use a PC in the school. A few students use the Internet Café.
- 50% of the students play a PC game and 30% has experience in using word processor, e-mail and learning material. Only 30% of the students often use a browser. (This is rather lower than excepted. It is now considered that Q3 Question ought to have used the word "Internet explore" instead of "browser")
- Many students seem to play the PC game home everyday. On the other hand, they do not have enough opportunity to access the Internet now, but if the Internet connectivity within schools is established, this situation will change.

**Figure 7.2.1 Result of Q1'How often do you use a computer?**

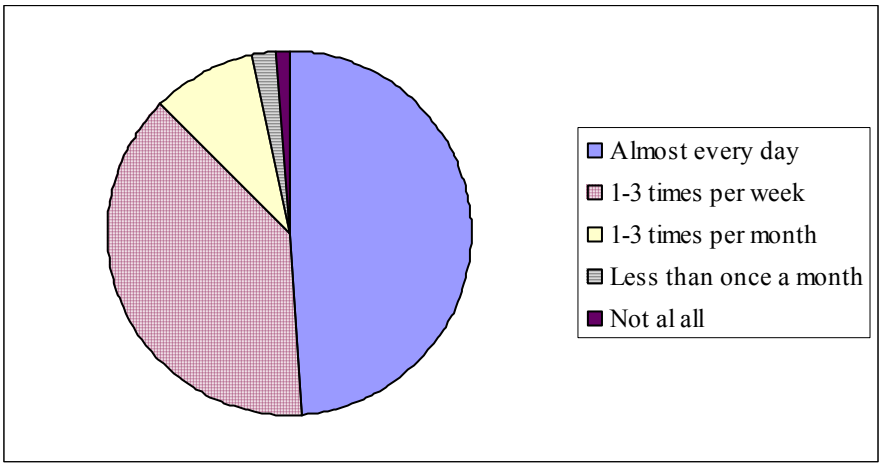



**Figure 7.2.2 Result of Q2 'Where do you use computer?'**

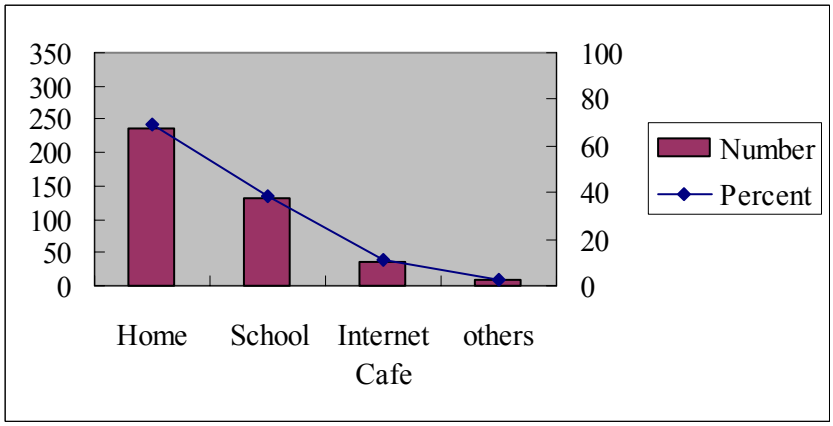
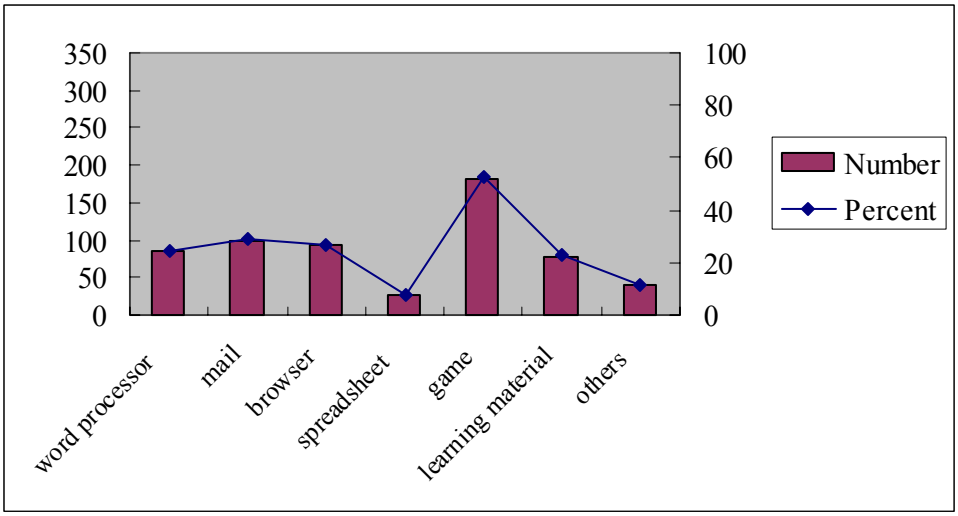


**Figure 7.2.3 Q3'What kind of software do you often use?'**




### 7.2.2 Learning Efficiency Results

1) Post-test

Table 7.2.2, 7.2.3 and Figure 7.2.4 display the results of the Post - Test. The Post Test consists of 20 questions, half of them are related to Chapter 9 and the others are related to Chapter 10. From the view of knowledge type, half of them are term and definition questions, and the rest are problem - solving. As ANOVA analysis Table 7.2.5 shows that the difference among the various mean values are significant ($F(2,342) = 33.450$, $P<0.01$). These results indicate that subjects in the E1 group (Self-learning) obtained higher scores than the other two groups ($MSe= 12.086$ $p<0.01$) (see Table 7.2.4). It implies that the self-learning with digital material in the Trial was very effective in improving students' skill and knowledge.

**Table 7.2.2 Result of Post- Test**

| Method | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD |
| E1 | 16.07 | 2.42 | 14.23 | 3.81 | 15.39 | 3.16 |
| E2 | 13.25 | 3.65 | 11.05 | 3.47 | 12.10 | 3.74 |
| Cont | 12.43 | 3.69 | 11.15 | 2.71 | 11.71 | 3.39 |

**Table 7.2.3 ANOVA of Post-Test**

| *Source* | *SS* | *df* | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| **Method** | 808.529 | 2 | 404.265 | 33.450 | 0.000 |
| Within Groups | 4060.798 | 342 | 12.086 | | |
| Total | 4869.327 | 344 | | | |

**Figure 7.2.4 Result of Post -Test**

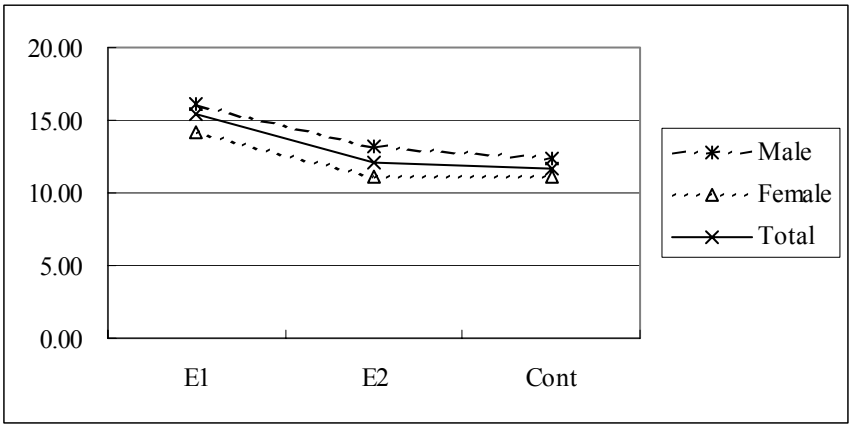



**Table 7.2.4 LSD of Post-Test**

| Method | E1 | E2 | Count |
|---|---|---|---|
| E1 | 0 | | |
| E2 | -3.287** | 0 | |
| Count | -3.672** | -0.385 | 0 |

MSe = 12.086

** P < 0.01

2) Pre-Test – Post-test

This report already mentions i) Three groups obtained same score in Pre-Test, and ii) E1 group is superior to E2 and Control groups (F (2,320) = 16.627, P<0.01). Table 7.2.5, Table 7.2.5 and Figure 7.2.5 illustrate the results of combined these facts.

**Table 7.2.5 Result of Pre-Test and Post-Test (Chapter 9)**

| Method | Pre-Test | | Post-Test | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| E1 | 3.58 | 1.84 | 7.26 | 1.85 |
| E2 | 3.25 | 1.34 | 5.65 | 1.81 |
| Cont | 3.53 | 1.47 | 5.44 | 1.90 |

**Figure 7.2.5 Result of Pre-Test and Post-Test (Chapter 9)**

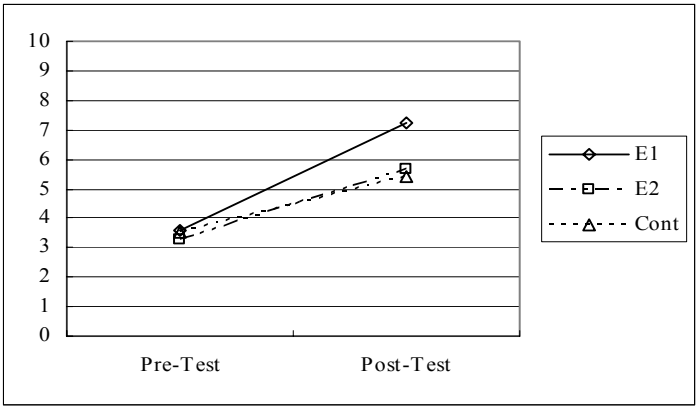



**Table 7.2.6 ANOVA of Pre and Post-Test**

| *Source* | *SS* | *df* | *MS* | *MS error* | *F* | *P* |
|---|---|---|---|---|---|---|
| **Method** | 112.887 | 2 | 56.444 | 3.336 | 16.920 | 0.000 |
| **Pre-Post** | 1111.051 | 1 | 1111.051 | 2.337 | 475.480 | 0.000 |
| **Method*Pre-Post** | 77.703 | 2 | 38.852 | 2.337 | 16.627 | 0.000 |
| Subjects | 1067.488 | 320 | 3.336 | | | |
| Subjects*Pre-Post | 747.742 | 320 | 2.337 | | | |
| Total | | 645 | | | | |

3) Factor: Knowledge type & Gender

Table 7.2.7 shows the detailed date of the Post –Test results and includes two factors 1) Knowledge type and 2) Gender.

**Table 7.2.7 Factor of Post–Test**

| | | Terms or Definition | | Intelligent Skill | | Total | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| E1 | Male | 7.74 | 1.60 | 8.33 | 1.27 | 16.07 | 2.42 |
| | Female | 7.40 | 1.88 | 6.83 | 2.24 | 14.23 | 3.81 |
| | Total | 7.63 | 1.72 | 7.76 | 1.86 | 15.39 | 3.16 |
| E2 | Male | 6.54 | 1.83 | 6.71 | 2.15 | 13.25 | 3.65 |
| | Female | 6.08 | 1.84 | 4.97 | 2.11 | 11.05 | 3.47 |
| | Total | 6.26 | 1.88 | 5.84 | 2.28 | 12.10 | 3.74 |
| Cont | Male | 6.16 | 1.96 | 6.27 | 2.03 | 12.43 | 3.69 |
| | Female | 6.15 | 1.73 | 5.00 | 1.78 | 11.15 | 2.71 |
| | Total | 6.04 | 1.90 | 5.67 | 2.02 | 11.71 | 3.39 |

Table 7.2.8 shows that the score of students in the E1 group are significantly different from the score of students in the other two groups and difference between male and female is significant (F (1,323) =

22.044, P<0.01). Furthermore, interaction between Method and Test-type is significantly different (F (2.325) = 38.430, P<0.01).

**Table 7.2.8 ANOVA of Factor 'Knowledge Type (Test-Type)' and 'Gender 'in the Result of Post-Test**

| *Source* | *SS* | *df* | *MS* | *MS error* | *F* | *P* |
|---|---|---|---|---|---|---|
| **Gender** | 123.287 | 1 | 123.287 | 5.593 | 22.044 | 0.000 |
| **Method** | 317.277 | 2 | 158.639 | 5.593 | 28.365 | 0.000 |
| **Method*Gender** | 6.282 | 2 | 3.141 | 5.593 | 0.562 | 0.571 |
| **Test-type** | 16.825 | 1 | 16.825 | 1.547 | 10.877 | 0.001 |
| **Method*Test-type** | 59.443 | 1 | 59.443 | 1.547 | 38.430 | 0.000 |
| **Gender*Test-type** | 8.058 | 2 | 4.029 | 1.547 | 2.605 | 0.075 |
| **Method*Gender*Test-type** | 0.086 | 2 | 0.043 | 1.547 | 0.028 | 0.973 |
| Subjects | 1806.433 | 323 | 5.593 | | | |
| Subjects*Test-type | 499.609 | 323 | 1.547 | | | |
| Total | | 657 | | | | |

Figure 7.2.6 and 7.2.7 are the results of Factor 'Gender 'in the Post-Test divided into 'Terms and definition' and 'Intelligent skill'. These graphs, Table 7.2.9 and 7.2.10 show interesting phenomena:

- Only 'Intelligent skill' score interacts between male and female significantly (F (1.323) = 46.045, P<0.01).
- 'Intelligent Skill' Score of male is better than female in all three groups. However, The Score of female in E1 group is almost equal to the Score of male of E2 and Control groups. Beside, the Score of male in E1 group is better than the Score of male of E2 and Control groups.
- 'knowledge and terminology' Score of both male and female in E1 group is better than two other groups; E2 and Control.

These results appear to support the general idea that "female is not good at science", but this notion cannot be concluded from the result of the experiment, because there are many other factors that would require examination.

**Figure 7.2.6 Factor 'Gender' in the Result of Post-Test (Terms or Definition)**

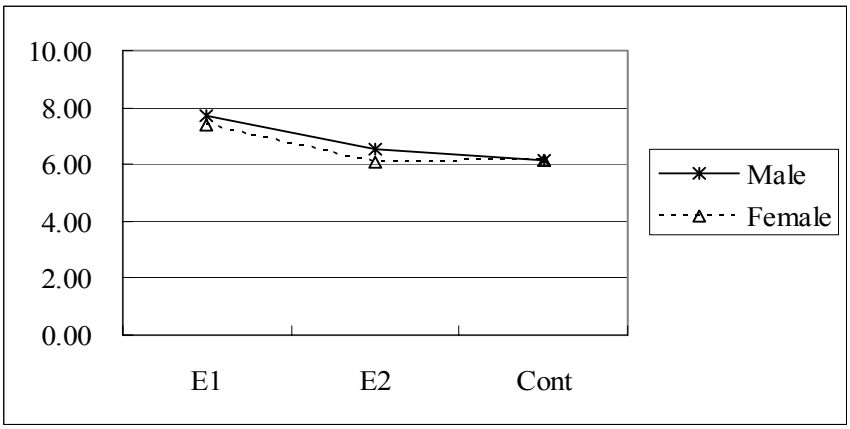


**Figure 7.2.7 Factor 'Gender'in the result of Post-Test (Intelligent Skill)**

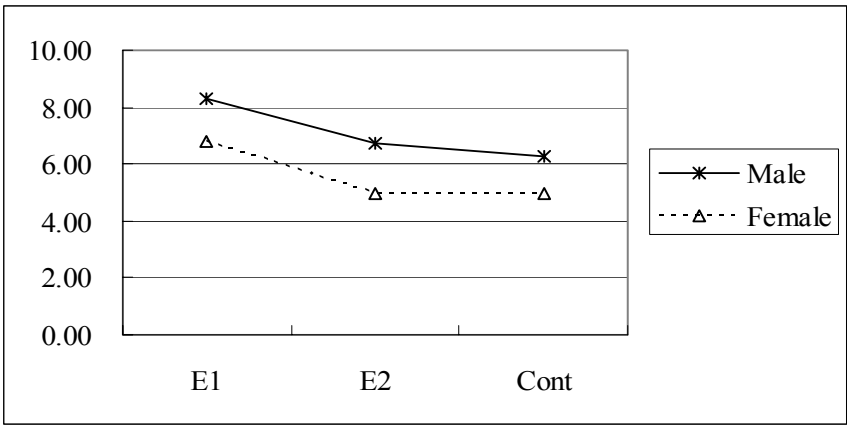



**Table 7.2.9 ANOVA of Factor 'Gender' in the Result of Post-Test (Terms or Definition)**

| *Source* | *SS* | *df* | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| **Gender** | 5.758 | 1 | 5.758 | 1.747 | 0.187 |
| **Method** | 112.123 | 2 | 56.062 | 17.009 | 0.000 |
| **Method*Gender** | 3.135 | 2 | 1.568 | 0.476 | 0.622 |
| Within groups | 1064.605 | 323 | 3.296 | | |
| Total | | 328 | | | |

**Table 7.2.10 ANOVA of Factor 'Gender' in the Result of Post-Test (Intelligent Skill)**

| *Source* | *SS* | *df* | *MS* | *F* | *P* |
|---|---|---|---|---|---|
| **Gender** | 176.971 | 1 | 176.971 | 46.045 | 0.000 |
| **Method** | 213.212 | 2 | 106.606 | 27.737 | 0.000 |
| **Method*Gender** | 3.233 | 2 | 1.616 | 0.421 | 0.657 |
| Within groups | 1241.437 | 323 | 3.843 | | |
| Total | | 328 | | | |

4) Factor: The digital material

4.a) Relation Between Prost-test score and the digital material

Table 7.2.11 shows the relation between questions and the digital materials, i.e. what kinds of learning objects are related to each question contained in the digital materials. Figure 7.2.8 illustrates the results of each question. The Counterpart who designed and knew details of the digital materials evaluated this result and concluded following tendencies.

- About moderate questions in difficulty, students got better score of questions, which have many learning objects in the digital materials.
- Especially concerning about 'Intelligent Skill', Good simulations that are complex and make student study actively seem to be effective and efficient. But, it is not sure whether simulations

are effective themselves or student's active study is effective. At least simulations give students an opportunity of active study.

**Figure 7.2.8 Result of Each Question in Post-Test**

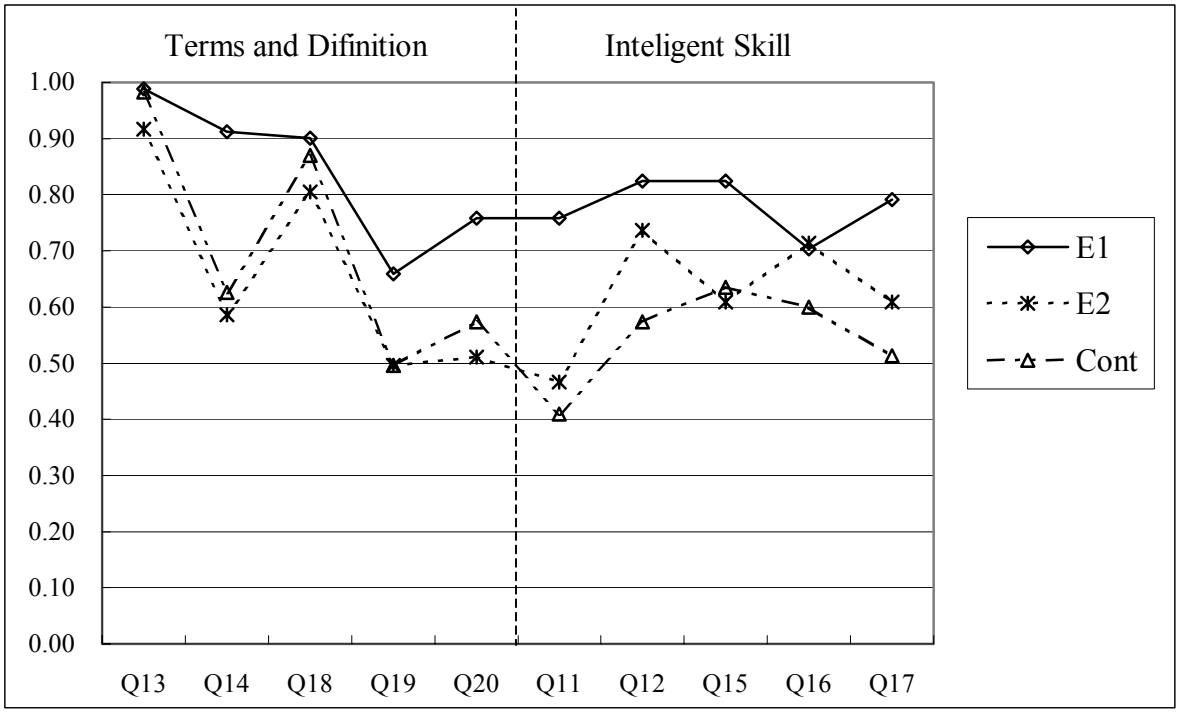



**Table 7.2.11 Score of Questions and Relation between Questions and the Digital Materials**

| | | Q13 | Q14 | Q18 | Q19 | Q20 | Q11 | Q12 | Q15 | Q16 | Q17 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Score | E1 | 0.99 | 0.91 | 0.90 | 0.66 | 0.76 | 0.76 | 0.82 | 0.82 | 0.70 | 0.79 |
| | E2 | 0.92 | 0.59 | 0.81 | 0.50 | 0.51 | 0.47 | 0.74 | 0.61 | 0.71 | 0.61 |
| | Cont | 0.98 | 0.63 | 0.87 | 0.50 | 0.57 | 0.41 | 0.57 | 0.64 | 0.60 | 0.51 |
| | *F (2,336)* | 4.86 | 16.13 | 2.21 | 3.62 | 7.32 | 15.09 | 8.52 | 6.55 | 2.1 | 8.88 |
| | | | ** | | | ** | ** | ** | ** | | ** |
| Materials | Explanation | | | | x | x | | | | | x |
| | Quiz | | x | x | | | x | | x | | |
| | Movie | | x | x | | x | x | | x | | |
| | Simulation | | x | x | x | | x | | | x | x |
| | Animation | x | x | | x | x | x | | x | x | |

X: The Digital Material has a learning object (Explanation, Quiz, Movie, Simulation and Animation) related each question.
**: $P < 0.01$

4.b) Impression for each lesson

The In-Trial Questionnaire was applied after each lesson. Ten questions are classified into four categories.

**Attention:**

*Q1) Do animations, simulations and narrations make you have interest in learning?*

*Q2) Do you think the contents of this lesson are different from ordinary class?*

**Relevance:**

*Q3) is the contents of this lesson familiar with you?*

*Q4) Can you find what is learning objectives in this lesson?*

*Q5) Does the content of lesson help you achieve the learning objectives?*

**Confidence:**

*Q6) Are you confident that you learn this lesson fully?*

*Q7) Do you think this lesson is difficult for you?*

*Q8) Do you learn various things by yourself, and can you look it up in these contents?*

**Satisfaction:**

*Q9) Do you think that the contents of this lesson has many content that make you be satisfied?*

*Q10) Does the subject of this lesson always give you the right directions?*

Table 7.2.12 shows the result of the In-Trial Questionnaire. The Counterpart related between the result of students' impression and the digital materials.

- The lessons that contain difficult formulae gave a negative impression to students. (for example Chapter 9 lesson 4 and 5, Chapter 10 lesson 2 and 3).
- Because some lessons have many contents, it is difficult for students to finish with in the lessen time. These lessons do not seem to get a good impression.
- Chapter 9 Lesson 11 and 12 contain a instruction for a real experiment in the laboratory, and these are a different type to the digital material from other.

**Table 7.2.12 Impression for Each Lesson**

| Chapter | Lesson | Attention | Relevance | Confidence | Satisfaction |
|---|---|---|---|---|---|
| 9 | 1 | 3.84 | 4.35 | 3.47 | 4.47 |
| 9 | 2 | 3.86 | 4.29 | 3.63 | 4.51 |
| 9 | 3 | 3.62 | 3.61 | 3.33 | *3.82* |
| 9 | 4 | 3.57 | *3.39* | *3.13* | *3.61* |
| 9 | 5 | *3.34* | *3.36* | *3.24* | *3.49* |
| 9 | 6 | 3.75 | 4.29 | 3.47 | 4.27 |
| 9 | 7 | 3.61 | 3.99 | 3.45 | 4.13 |
| 9 | 8 | 3.69 | 4.12 | 3.45 | 4.19 |
| 9 | 9 | 3.58 | *3.56* | 3.34 | *3.67* |
| 9 | 10 | 3.67 | 3.81 | 3.36 | 3.94 |
| 9 | 11 | ***3.31*** | *3.35* | ***3.10*** | ***3.47*** |
| 9 | 12 | ***3.35*** | *3.51* | 3.15 | *3.54* |
| 10 | 1 | 3.50 | *3.34* | ***3.10*** | *3.48* |
| 10 | 2 | 3.45 | ***3.05*** | ***2.99*** | ***3.03*** |
| 10 | 3 | ***3.10*** | ***2.86*** | ***2.84*** | ***3.07*** |
| 10 | 4 | 3.69 | 4.30 | 3.43 | 4.49 |
| 10 | 5 | 3.63 | 4.09 | 3.36 | 4.32 |
| 10 | 6 | 3.64 | *3.70* | *3.22* | 3.96 |
| 10 | 7 | 3.56 | 3.93 | *3.25* | 4.22 |
| 10 | 8 | *3.40* | *3.47* | *3.21* | *3.85* |
| 10 | 9 | 3.58 | 3.89 | 3.32 | 4.31 |
| 10 | 10 | *3.52* | *3.59* | 3.25 | 3.98 |
| 10 | 11 | 3.61 | 3.80 | 3.29 | 4.21 |
| 10 | 12 | 3.66 | 3.94 | 3.37 | 4.25 |
| Mean | | 3.56 | 3.73 | 3.28 | 3.93 |
| SD | | 0.17 | 0.40 | 0.17 | 0.43 |
| Mean-SD*1 | | 3.39 | 3.33 | 3.11 | 3.50 |

Note: Under Average: Italic Under Mean – SD*1

### 7.2.3 Learning Attitude Results

The Pre- Questionnaire consists of eighteen questions and the Post- Questionnaire consists of nineteen. Both questionnaires have questions related to students' attitude such as whether or not they like computer and/or they like physics. (see Table 7.2.13)

**Table 7.2.13 Result of Pre and Post–Questionnaire Related Attitude**

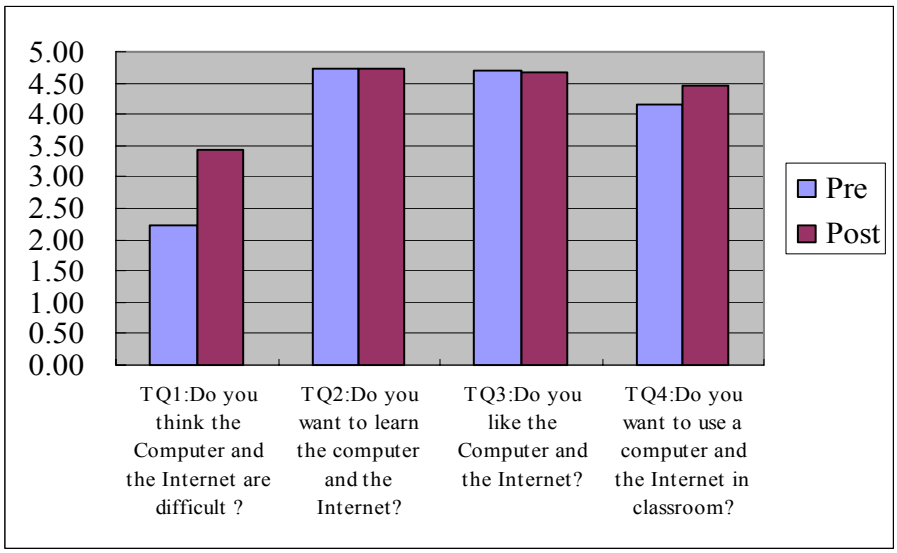
| | Questionnaire Item | Pre | Post | Score: 5 | Score: 1 | Pre: Mean | Post: Mean |
|---|---|---|---|---|---|---|---|
| TQ1 | Do you think the Computer and the Internet are difficult? | Q5 | Q1 | Difficult | Easy | 2.22 | 3.42 |
| TQ2 | Do you want to learn the computer and the Internet? | Q6 | Q2 | Want | don't | 4.72 | 4.73 |
| TQ3 | Do you like the Computer and the Internet? | Q7 | Q3 | Like | Dislike | 4.69 | 4.67 |
| TQ4 | Do you want to use a computer and the Internet in classroom? | Q8 | Q10 | Want | don't | 4.15 | 4.45 |
| TQ5 | Do you like to watch science TV program and read science books? | Q9 | | Like | Dislike | 3.88 | |
| TQ6 | Do you like the subject "Physics" in school? | Q10 | Q4 | Like | Dislike | 3.10 | 4.26 |
| TQ7 | Do you like experiments such as physics, biology, geology or chemistry? | Q11 | Q5 | Like | Dislike | 4.26 | 4.35 |
| TQ8 | Do you like to study formulas of the subject "Physics" ? | Q12 | Q6 | Like | Dislike | 2.73 | 4.17 |
| TQ9 | Do you want to continue a self-learning using digital materials? | | Q7 | Want | don't | | 3.99 |
| TQ10 | Do you think the digital materials help you study subject "Physics" easily? | | Q8 | Yes | No | | 3.96 |
| TQ11 | which do you prefer to study …..? | | Q9 | e-leaning | Ordinal | | 3.84 |

1) Attitude about IT

Questions No.5, 6, 7 and 8 in Pre-Questionnaire and No.1, 2, 3 and 10 are related to attitude about IT. Average scores of TQ2, TQ3 and TQ4 are very high in both Pre-questionnaire and Post- questionnaire. This is why the difference between Pre and Post is not significant. It is apparent that students have a high interest in IT and were willing to use IT before the Trial. Students maintained these impression, or rather strengthened it after the Trial. At least, it indicates that the digital material did not defeat their attitude about IT and e-learning. In comparison with this, the result of TQ1 illustrates that students feel PC and the Internet are more complex after the Trial than before the Trial.
($Z = 6.274$, $P<0.01$: Wilcoxson's sign rank sum test) (see Figure 7.2.9)

It can be assumed that Students have had a little experience of IT before the Trial, then they have used a PC in the classroom and using a PC is more complex than they expected. ('7.2.1 Base line' mentions that almost the students use a PC as a game machine)

**Figure 7.2.9 Attitude about IT**



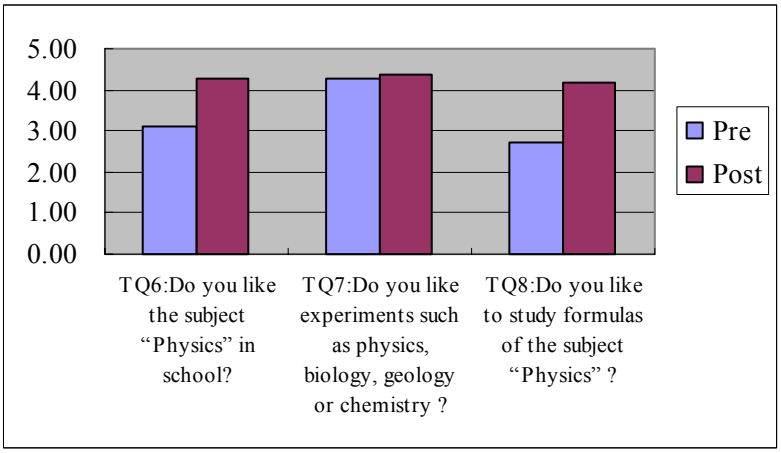

Note: refer to Table 7.2.13 for score definition for the score in the vertical axis

2) Impression and Attitude for Physics

TQ6, 7 and 8 asked students how they feel about Physics. It is obvious that students do not like physics, and in particular they had a neutral impression about formulae in Physics before the Trial. But, Q7 shows students enjoy experiments very much, and teachers should keep this fact in mind.

Concerning the effect of the trial, the differences of TQ6 ($Z=5.935$, $P<0.01$) and TQ8 ($Z=6.819$, $P<0.01$) between Pre and Post are significant (see Figure 7.2.10) It is obvious that Student's impression of Physics is improved substantially .In particular, many students felt that formulae in Physics was not difficult after using the digital materials.

**Figure 7.2.10 Impression for Physics**

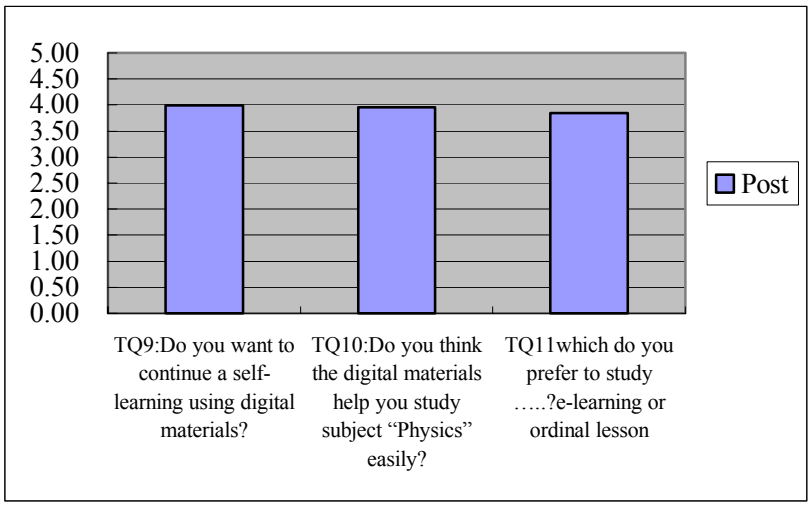



Note: refer to Table 7.2.13 for score definition for the score in the vertical axis

3) Impression for e-learning

Students have a good impression of IT and aspire to use IT in the classroom (see 7.2.13) Attitude about IT above), For this reason, it is difficult to determine whether the Trial improved the students' motivation for using e-learning. But the result of TQ9, 10 and 11 shows that many students have or maintain positive feeling for e-learning after the Trial, at least the digital material do not disappointed them.

**Figure 7.2.11 Impression for E-learning**




Note: refer to Table 7.2.13 for score definition for the score in the vertical axis

# 8

# WORKSHOP

## 8.1 Preparation of Workshop

The JICA study team held a workshop for those concerned with education and e-learning.

**Purpose:**

- To spread the knowledge and skills that the Counterpart has obtained in this project. Specifically, this is how to develop digital materials and to use them in schools.
- To report the result of the trial; i) effect of the digital materials and ii) practice in school.
- To teach attendances how to use the digital materials that the project developed.

**Participants:** over 150 people

- Physics teachers and Physics supervisors at local educational bureaus
- Officials of MOE

**Date:**

- 22nd and 23rd of May 2003

**Material:**

- Power Point slide and handouts
- The Counterpart prepared all of these

**Program:**

**Table 8.1.1 Workshop Program**

| Day | Session | Time | Activity | The Speaker |
|---|---|---|---|---|
| 22nd | 1 | 9-10 | Opening the workshop | 1.Mr. Inagaki (JICA)<br>2.The Minister<br>3.Mr.Ota (PADECO) |
| | 2 | 10-10.30 | Break | ---------- |
| | 3 | 10.30-11 | Introduction of e-learning | Mr.Qasem |
| | 4 | 11-12 | Process of the project | Dr.Ziad |
| | 5 | 12-1.00 | Multimedia +Text | Menhaj<br>Ms. Najwa |
| | 6 | 13-14 | Lunch | ---------- |
| | 7 | 14-15 | Experience of the visit to Japan | Mr .Dwekat |
| | 8 | 15-16 | Results of Trials and Teachers experience | Dr.Mekhled<br>Mr.Ibraheem |
| 23rd | 1 | 9-10.30 | Practice and use | All of the Counterpart |
| | 2 | 10.30-11 | Breakfast | ---------- |
| | 3 | 11-12 | Practice and use | All of the Counterpart |
| | 4 | 12-12.15 | (Deliver the CD + Workbook) | All of the Counterpart |

## 8.2 Results of Workshop

**Participants:**

- Physics teachers, IT teachers and Physics supervisors at local educational bureaus - 100
- Members of MOE – 35

**Results of questionnaire**

The Counterpart prepared and applied a questionnaire. Result of questionnaire shows some features of Supervisors and teachers (Table 8.1.2).

**Table 8.1.2 Results of Questionnaires (Workshop)**

| | Question | Average of the questioners scale | | |
|---|---|---|---|---|
| | | Supervisor | Physics Teacher | IT Teacher |
| 1 | Your Impression about workshop: Unuseful 1 2 3 4 5 Useful | 4.3 | 3.7 | 4.5 |
| 2 | Did you have previous knowledge about digital material: Little 1 2 3 4 5 much | 2.1 | 2.4 | 3 |
| 3 | Is The digital material: Difficult 1 2 3 4 5 easy | 4.1 | 3.6 | 4.6 |
| 4 | Was the digital material: not clear 1 2 3 4 5 Clear | 4.2 | 3.5 | 4.5 |
| 5 | The facilities which offered for trainees were: not suitable 1 2 3 4 5 Suitable | 4.4 | 3.7 | 4.1 |

| | Paragraph | Percentage of the presentation | | |
|---|---|---|---|---|
| 6 | Which one of the presentations were useful for you (choose one or more): | Supervisor | Physics Teacher | IT Teacher |
| (1) | Introduction in the E-learning | 66% | 41% | 46% |
| (2) | The practical process for physics digitalization | 78% | 38% | 42% |
| (3) | Making the scientific texts fit with the multimedia | 72% | 54% | 72% |
| (4) | Japanese experiences in educational learning | 48% | 48% | 36% |
| (5) | Notes of the teacher which implemented digital material | 51% | 38% | 40% |
| (6) | Results of the implementation of the trail school | 39% | 30% | 30% |

| | Paragraph | Percentage of choosing skills | | |
|---|---|---|---|---|
| 7 | Which kind of skills do you want to learn? | Supervisor | Physics Teacher | IT Teacher |
| (1) | Basic skills of computer | 21% | 10% | 18% |
| (2) | Development of digital material | 78% | 48% | 70% |
| (3) | Using the IT In classroom | 72% | 10% | 82% |
| (4) | Using the communication technology and internet | 72% | 65% | 70% |

# 9

# RECOMMENDATIONS

## 9.1 Government Planning

Work on education reform has commenced in Jordan. The results of this project suggest that application of digitized materials strengthens students' learning initiative and resultant learning efficiency. If cost is affordable, it seems important to place the application of IT in the center of education reform in order that a dramatic change takes place in the education sector. The following show some recommendations.

### 9.1.1 Government Roles

In comparison with the conventional paper-based education, the application of IT requires more in that the government makes comprehensive plans and monitor their implementation. Basic areas of government responsibilities include the following:

- Provision of infrastructure including installation of PCs in schools, connection to the Internet, and their maintenance
- Provision of digitized materials and organizational structure for their development
- Dissemination of application including the training of teachers

The Ministry of Education should promote the balanced development of the above three by means of development of organizational structure within the Ministry, deployment of private companies and foreign donors.

### 9.1.2 Development Organization

(1) Needed Human Resource and Organization

The field of IT demands highly specialized technical knowledge and capabilities that evolve at a high speed. On the other hand, the field of education demands learned experience as well as education techniques. The application of IT in education requires persons who can flexibly cope with both and organizations that can accommodate such persons. Organization for the purpose should have the following features:

- **Organization consisting of varied human resources:** It is extremely difficult for a single person to possess both of the above requirements, although education expert should have basic knowledge in IT. Therefore, the organization should be build to accommodate varied human resources. It is therefore necessary to set up a mechanism to make information common to all. In cases, it would be desirable to have government personnel and private sector personnel working together, such as the case in this project.

- **Organization capable of formulating feasible plans and implementing them:** Such organization must have a system accurately managing activities of varied human resource. In

addition, as the field of IT calls for concrete output in the form of software or system, the ability to make feasible plans is important.

- **Organization capable of absorbing new knowledge and application with its own initiative:** Organization and individuals alike must absorb rapidly advancing technologies. Individuals must acquire them by their own initiative by means of web sites and communities in the Internet. Such initiative requires considerable time and effort for individuals, and therefore, organization should properly reward such individuals.

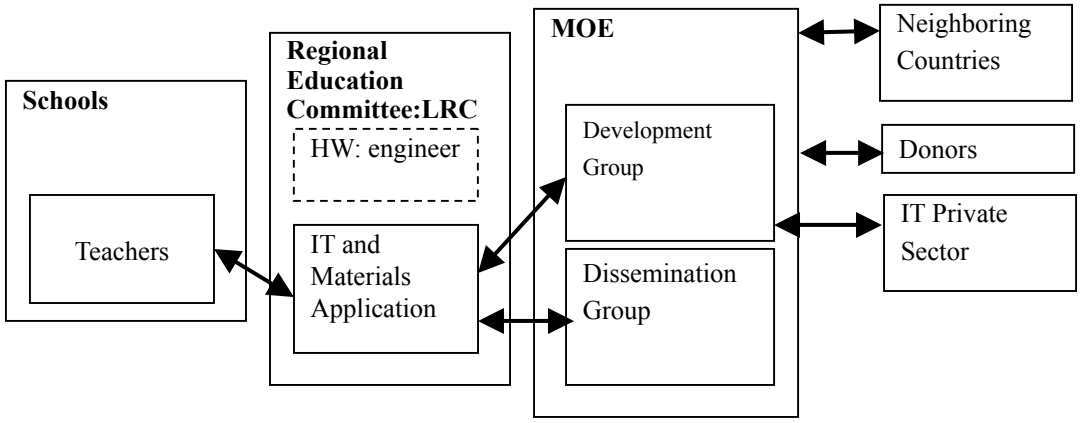
(2) Organizational Structure

Figure 9.1.1 shows necessary players in the context of education reform in Jordan for the purpose of dissemination of digitized materials excluding infrastructure and maintenance. Main vessels are the three stages of the Ministry, regional education committees, and schools, and their roles are:

**Ministry of Education:** Plans and implements research, development, application, and dissemination of digitized materials while contacting neighboring countries and donors.
**Development Group:** Develops most effective materials utilizing available resources in cooperation with the private sector.
**Dissemination Group:** Develops and disseminates applications in conjunction with various tools and information collection through Internet.
Regional Education Committees and Learning Resource Centers: Develops curriculum and teaching methods suitable to the realities of the region and provides support to schools.
**IT and Materials Application:** Teaches IT and materials to teachers in schools and supplies materials developed by itself responding to requests by teachers.

Schools and Teachers: Implements application in respective schools. Informs the results and requests to rational education committees and LRCs.

**Figure 9.1.1 Organization for digital material in Jordan**



(3) Roles of Teachers

While students' initiatives are expected to play a major role in the education reform, teachers themselves are also expected to learn new methods and approaches on their own initiative. Internet provides a world of equal access to all and every teacher can access new methods and approaches.

At minimum teachers are expected to possess the following capabilities:
- Typing in Arabic
- Using tools for materials preparation such as Word and Power Point
- Using the Internet and email

Following capabilities are desirable:
- Knowing websites for effective information in responsible education subject
- Using effectively Word, Excel, and Power Point for the responsible subject
- Using the Internet for collaborative learning
- Using digitized materials effectively

For teacher training purposes, some programs have already been initiated in Jordan such as ICDL or Intel Program. The Ministry of Education should lead the following activities in order to support individual teachers' effort:

- Formation of teachers' virtual community on the Internet using such tools as Bulletin Board System (BBS) and Mailing List
- Holding of contest for the best teaching method (not programming, but lesson plan)
- Public call among teachers for pilot projects on IT application in education

### 9.1.3 Planning

(1) Comprehensive Planning

A considerable amount of cost and human effort is necessary to develop digitized materials and IT application in education. Proper preparation of short and long-term plans is essential. Long time period is needed for implementation and so is maintenance. At the same time, work must be done on how to improve conventional classroom education. Therefore, plans should be prepared for the following three cases:

- Plan assuming a full use of PC in classroom with one for each student
- Plan assuming several PCs in a classroom
- Plan assuming the use of materials in printed form

These plans may be prepared under a master plan with a planning period of 3-5 years and including short-term plans of 1-2 years such as this project.

(2) Subject of Development

It is necessary to consider the amount of available time of computer use for each student. At present, 5-8 hours per week for each student is available. The pace of materials development would match the increase in available time. Subjects for digitization should not be a whole textbook subject but be selected portions. External conditions such as accessibility to information on websites in English should also be taken into account.

(3) Human Resource Development

Broadly, necessary personnel can be classified into 1) curriculum analysis and materials design, and 2) programming and graphic design. The latter can be relied on the private sector and the Ministry should concentrate its effort in the first category provided that a sufficient number of personnel knowledgeable in the latter exist within the Ministry. The former is now called Instructional Designer and its required system of knowledge and skills are compiled as Instructional Design, for which training courses are beginning to appear. Supervisors or teachers with sufficient experience in education and knowledge in IT can be relatively easily trained to be Instructional Designer.

## 9.2 Capacity building and Technical Transfer

The overall objective of the project is to develop the capability of the government of Jordan to plan, specify and order digital teaching materials. As this document mentions previously, the project had good progress about technical transfer that made splendid digital materials and curried out the trial in schools. Table 9.1.1 shows the Skill map and achievement of Technical Transfer. Though the project is only one year, Achievement was very good and the Counterpart acquired the skills. However, usually it takes over three years to train Instructional designers and over five years to train Project managers, the Counterpart need to get more kills and knowledge about e-learning.

**Table 9.2.1 Skill Map for Development of Digital Materials**

| Category | Phase | Task | Achievement of Technical Transfer in the Project | | |
|---|---|---|---|---|---|
| | | | Basic | Intermediate | Professional |
| Plan | Needs assessment | Situation analysis | ---- | | |
| | | Goal analysis | ---- | | |
| | Plan | Short term | + | | |
| | | Long term | ---- | | |
| Development | Front-end analysis | Curriculum analysis | + | + | |
| | | Learner analysis | + | | |
| | | Technology analysis | ---- | | |
| | | Cost-benefit analysis | ---- | | |
| | Design | System | + | | |
| | | Course Design | + | | |
| | | Detail Design | + | + | |
| | | Program Design | ---- | | |
| | Development | Develop(Graphic) | ---- | | |
| | | Develop (Audiovisual) | ---- | | |
| | | Develop (Program) | ---- | | |
| | | Debug | + | + | |
| | | Formative evaluation | + | | |
| | | Test | + | | |
| | Evaluation | Experiment plan | + | | |
| | | Trial | + | + | |
| | | Data collection | + | | |
| | | Data analysis | ---- | | |
| | | Evaluation | + | | |
| Management | Tender | Tender document | + | | |
| | | Bidding | + | | |
| | | Evaluation Procedure | + | + | |
| | Project | Schedule | + | | |
| | | Cost | ---- | | |
| | | Specification | + | | |
| | | Quality | + | | |
| | | Contractor | + | + | |

----: Out of scope for Technical transfer to the Counterpart

## 9.3 Development of Digital Material

For the Counterpart assigned by the Ministry of Education, this Project offered the first experience in such work. They completed the whole work despite confronting problems arising from 1) the inherent difficulty in digital materials development, and 2) the work content completely difference from their past background as teachers and supervisors. The following recommendations were made reflecting these problems encountered during the process.

### 9.3.1 Development Management

Anywhere in the world, teachers are not accustomed to be managed by work schedule tables or output requirements which private companies make. Counterparts gradually understood the meaning of such management, especially the deadline for completion. One notable problem arose because of developing materials for 24-hour lessons all at once. Development work follows the stages of basic design, detailed design, production, and testing. Initially the counterparts proceeded work without realizing the whole picture, e.g. not knowing the meaning of basic design while working on it. They finally realized the meaning of each stage after completing the last stage. In future, it is better to develop materials for short

lesson hours such as 2-3 hours first as a whole so that whole process can be understood first. Then a large amount can be tackled afterwards.
Documents prepared in the early stages of the projects were done entirely in long hand and modifications were difficult. Trainees should be trained first to be able to use editing tools such as Word and Excel.

### 9.3.2 Textbook Analysis

In the case of materials development for private corporations textbook analysis and learner analysis are considered the most important stage. In the education environment in schools learning objectives are readily established by the authority and it seemed hard for the counterparts to understand the meaning of this work stage. By the time of project completion, however, they understood the necessity of defining targets far more finely than those defined by the Ministry for the purpose of materials development.
As for learner analysis, the counterparts found it difficult to explicitly document the level of understanding of learners as they, as teachers, unconsciously understood the level. This caused difference in opinion between the private sector production company and the counterparts concerning the methods of explanation in digital materials.

### 9.3.3 Design and Specifications

At the beginning, the counterparts had little images on simulation and animation. They formed opinions after seeing the product as a result of design and requested modifications. This caused extra delay and effort. Digital materials developed by this project contains all types of simulation and animation, etc. and they are very effective as a sample for future trainees. The materials developed by this project have been lavishly designed, maybe a little excessively. Future work may be done somewhat simplified by focusing only on the most effective elements, case by case.

### 9.3.4 Tender Conditions and Process

Tender process in this project was completely done in a transparent and fair manner. As a result, a very competent private firm was selected. Especially, a request to provide a sample demonstration proved to be an effective tool for evaluating each firm's capability. The counterparts sufficiently possessed evaluation criteria beforehand as experienced teachers.

### 9.3.5 Materials Development Methods

A programmer can spot mistakes and correct them when the subject is at primary school level. In this project, only the counterparts could detect errors as the subject was Grade 11 Physics. As a result correction process was time consuming and minor mistakes took long time to be corrected. This communication between programmers and materials designers is a big issue for the future. Conceivable measures may include debug at document basis, statistical control of errors, setting of clear deadline.

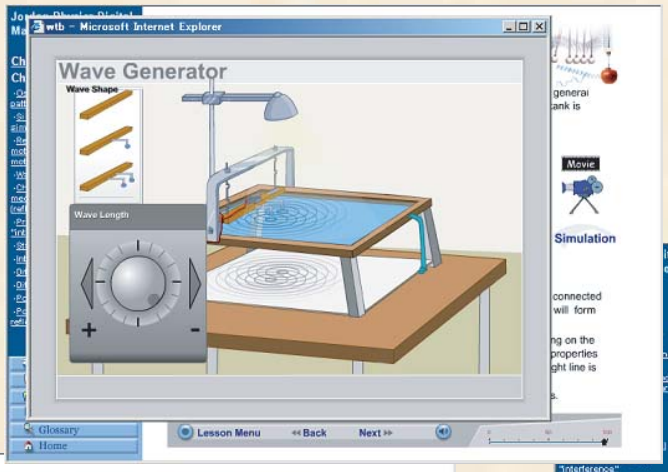
### 9.3.6 Monitoring and Feedback

This project included questionnaire survey and built-in answer log for the purpose of evaluating the effectiveness of the materials, and precious information were obtained for improving the materials. One inherent problem of e-Learning system is the large amount of data and subsequent difficulty in analysis. It is necessary to develop a system of automatic execution of monitoring and feedback if evaluation of e-Learning materials is to be done as a long term objective. It is also desirable to analyze finer reactions of students by making films of students' behaviors and carry out video analysis although no such attempt was made in this project.

## 9.4 Future Paths

This project is uniquely high-level with little example of comparable level even in developed countries of the US, Europe or Japan as to the quality of the developed materials, the implementation of the large scale pilot application, and the subsequent large scale evaluation survey. The application of IT in education has only a short history anywhere in the world. The results of this project suggest the possibility for Jordan to cut the leading edge in the world in this field. If the education reform is proceeded with the following points in mind, Jordan can attain the top position.

- Plans centered around the capability improvement of teachers and MOE officials, and provision of environment and systems supporting individual initiatives
- Student's initiative as the central target of learning and a system to support this by IT technologies
- Varied application of IT not limited to digital materials


wtb - Microsoft Internet Explorer
Wave Generator
Wave Shape
Wave Length
Movie
Simulation
Glossary
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Lesson Menu
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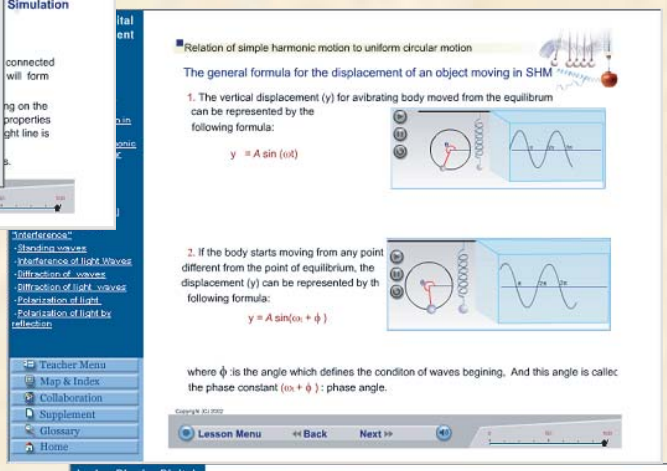
Relation of simple harmonic motion to uniform circular motion
The general formula for the displacement of an object moving in SHM
1. The vertical displacement (y) for avibrating body moved from the equilibrum can be represented by the following formula:
y = A sin (ωt)
2. If the body starts moving from any point different from the point of equilibrium, the displacement (y) can be represented by th following formula:
y = A sin(ωt + ϕ )
where ϕ :is the angle which defines the conditon of waves begining, And this angle is callec the phase constant (ωt + ϕ ) : phase angle.
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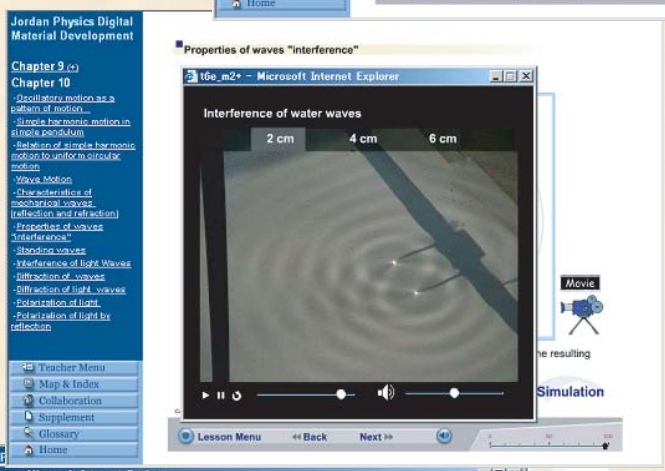
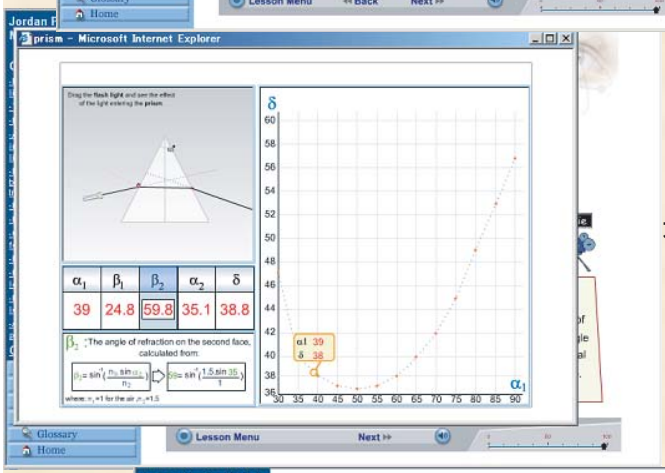
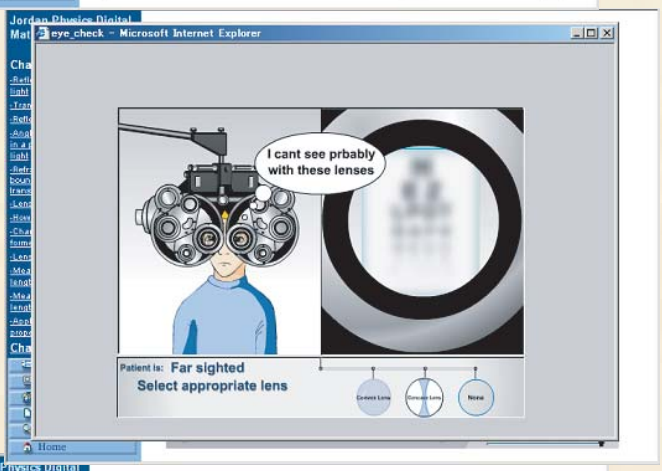
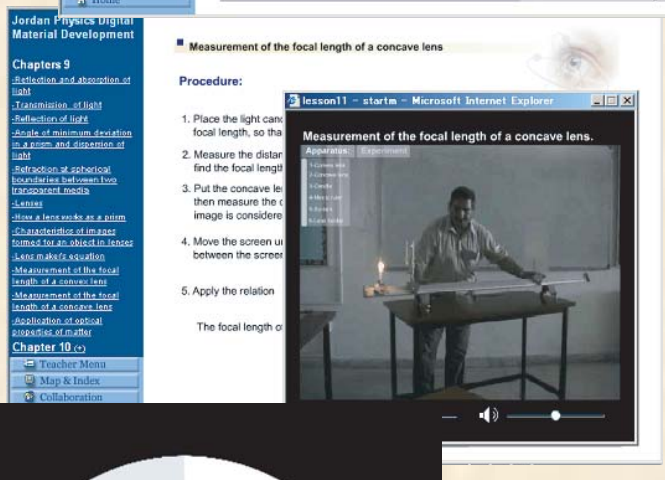
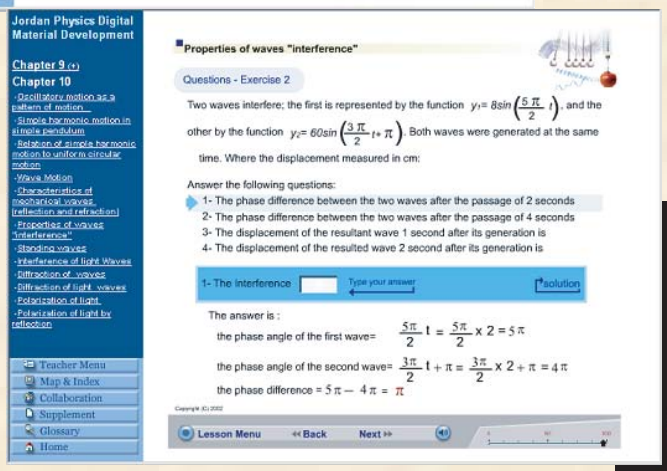

Jordan Physics Digital Material Development
Chapter 9
Chapter 10
Properties of waves "interference"
Standing waves
Interference of light Waves
Diffraction of waves
Diffraction of light waves
Polarization of light
Polarization of light by reflection
Teacher Menu
Map & Index
Collaboration
Supplement
Glossary
Home
t6e_m2+ - Microsoft Internet Explorer
Interference of water waves
2 cm
4 cm
6 cm
Movie
Simulation
Lesson Menu
Back
Next


prism - Microsoft Internet Explorer
α1 β1 β2 α2 δ
39 24.8 59.8 35.1 38.8
β2 :The angle of refraction on the second face, calculated from:
Glossary
Home
Lesson Menu
Next


eye_check - Microsoft Internet Explorer
I cant see prbably with these lenses
Patient is: Far sighted
Select appropriate lens
Home

JICA


Jordan Physics Digital Material Development
Chapters 9
Chapter 10
Measurement of the focal length of a concave lens
Procedure:
lesson11 - startm - Microsoft Internet Explorer
Measurement of the focal length of a concave lens.
Apparatus
Experiment


Jordan Physics Digital Material Development
Chapter 9
Chapter 10
Properties of waves "interference"
Questions - Exercise 2
Two waves interfere; the first is represented by the function y1= 8sin (5π/2 t), and the other by the function y2= 60sin (3π/2 t+ π). Both waves were generated at the same time. Where the displacement measured in cm:
Answer the following questions:
1- The phase difference between the two waves after the passage of 2 seconds
2- The phase difference between the two waves after the passage of 4 seconds
3- The displacement of the resultant wave 1 second after its generation is
4- The displacement of the resulted wave 2 second after its generation is
1- The interference
Type your answer
solution
The answer is :
the phase angle of the first wave= 5π/2 t = 5π/2 x 2 = 5π
the phase angle of the second wave= 3π/2 t + π = 3π/2 x 2 + π = 4π
the phase difference = 5π − 4π = π
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أنا أحب الفيزياء
مشروع حوسبة مادة الفيزياء
2002-2003
JICA
ARDECO
1/3
الوكالة اليابانية للتعاون الدولي
وزارة التربية والتعليم الأردنية
شركة نادكو م.م
تطوير :
شركة منهاج م.م
جميع الحقوق محفوظة