CHAPTER VI

RESULTS AND DISCUSSION

Result of this work includes of two important parts. First is the completed CAI software on CD-ROM and the second is a research result on software effectiveness. Both results are summarized and discussed as following.

6.1 CAI software (EM-CAI)

The CAI named "Multimedia Tutorial Guide for Engineering Metallurgy course" or EM-CAI was developed following a procedure described in Chapter 4. It contain many simulations entire the lessons to help for explanation in difficult topics and to make the lesson more interesting. It was finally prepared as a ready to use CD-ROM. Learners can use this software in two ways as described belows:

1) Setup the program onto a local hard disk and play by openning the shortcut icon.

This EM-CAI included a setup file named "Install.exe" for installation already. This setup file will help user to install software easily. By double-clicking "Install.exe" file, the setup file copies all relavant files of EM-CAI to local harddisk, prepares font resource and creates shortcut icon on the desktop automatically. After finish a setup process, user just double-clicking the shortcut icon on desktop to open the CAI.

2) By playing with the CD-ROM using auto-run feature.

User can use this software by playing with the CD-ROM without installation. The software is included auto-run feature for readily use on high performance computer. By this feature, EM-CAI will be executed automatically when CD-ROM is inserted to CD-ROM drive.

After open the software, by any ways, it starts with short title and follows by main menu as shown in Figure 6.1a. Learner can access any interested parts from each interaction button.

The course contents can be accessed through the third button named "What is inside" and the chapter can be selected from submenu designed in various color spheres as shown in Figure 6.1b. The corresponding contents selected will be displayed (see Figure 6.1c, for example).

Each chapter has the same interface (i.e. scene and button). The scene contains three parts including "Header", "Presentation" and "Navigator bar" as shown in Figure 6.2.

The Header part (Figure 6.3) includes the faculty logo, the subject name, the chapter name and the drop-down menu that inform the user the current point of studying. Furthermore, the drop-down menu is used to select the subtopic in the current chapter.

The Presentation part is used to display the contents (text, graphic,animation) of each chapter (see Figure 6.2).

The Navigator bar is used to explore the lesson and displayed some informations as shown in Figure 6.4.

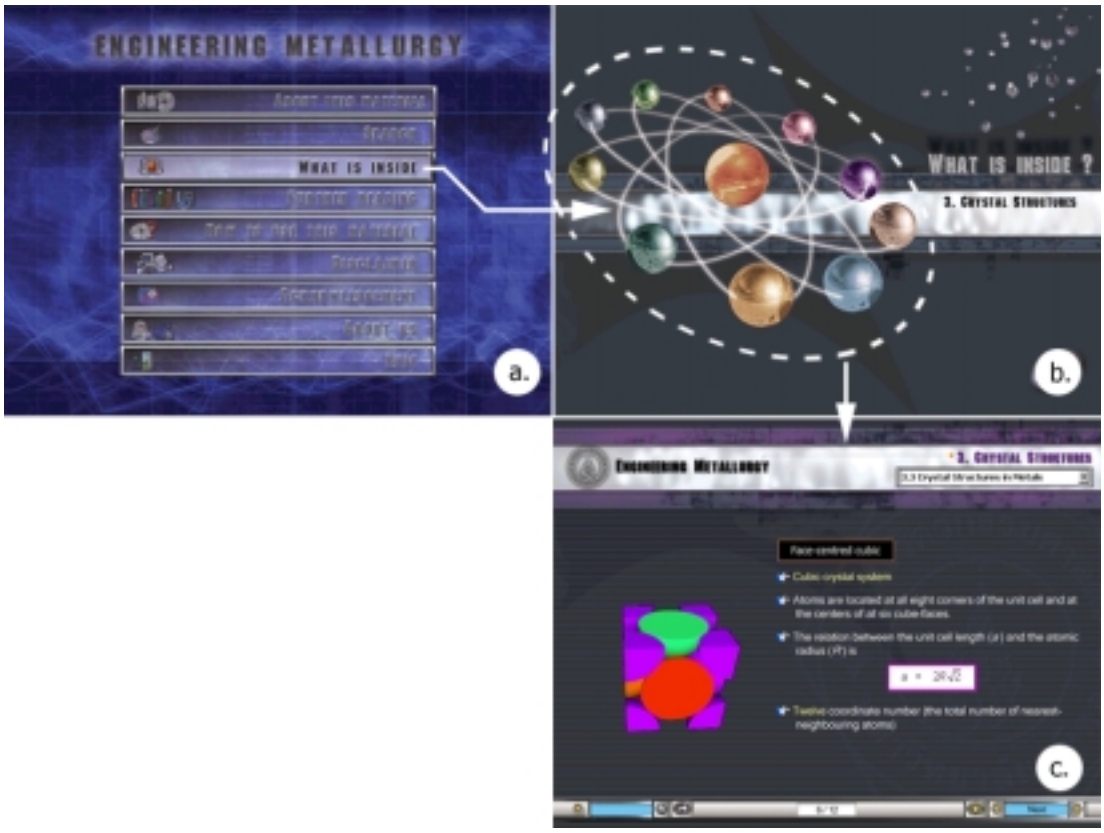


Figure 6.1 Figure shown various scenes of the CAI (a) main menu, (b) submenu of "What is inside" and (c) selected contents scenes.

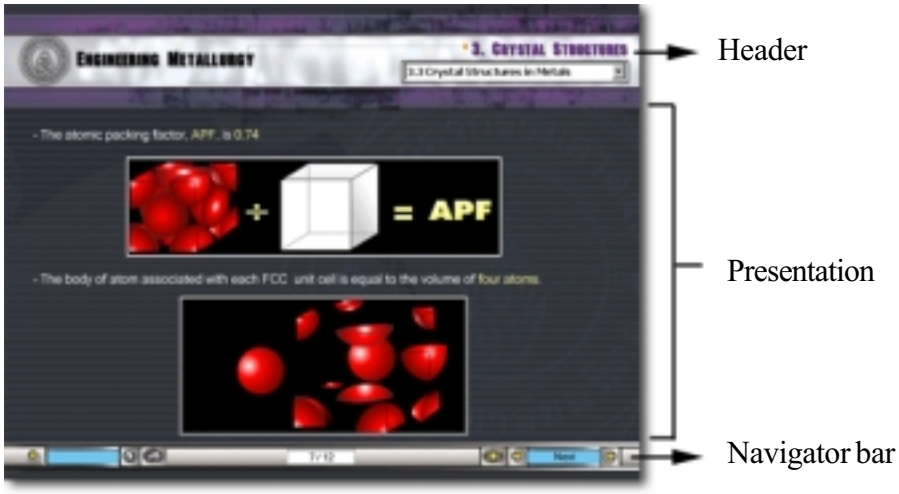


Figure 6.2 Three parts of each chapter's scene including "Header", "presentation" and "Navigator bar".

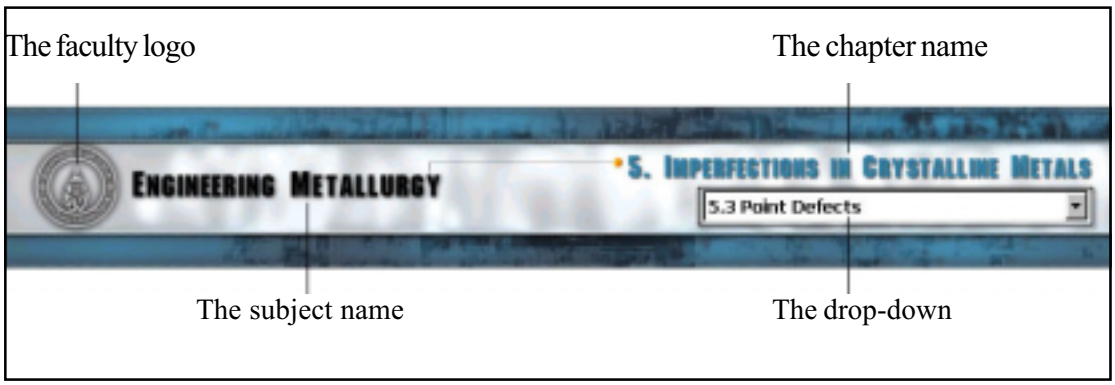


Figure 6.3 Header part and its components.

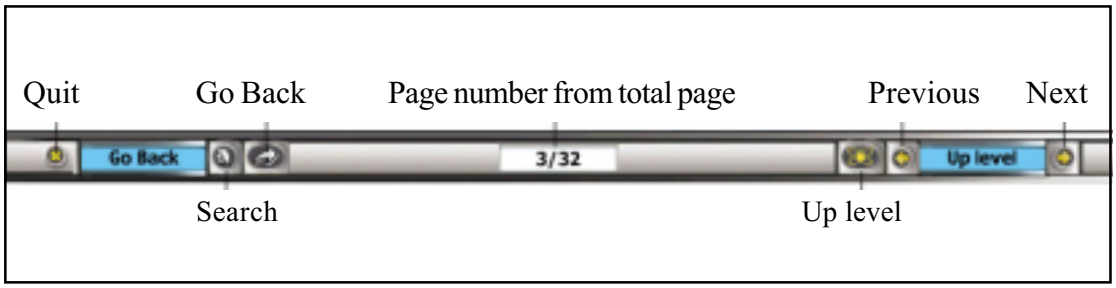


Figure 6.4 Navigator bar with the name of each component

6.2 Effectiveness of CAI software

Effectiveness of the EM-CAI was evaluated by using three different method including questionnaire, t-test and Meta-analysis as described in section 5.1 to 5.3. The results obtained can be summarized as following.

6.2.1 Questionnaire

The learner's attitude on this EM-CAI is measured by questionnaire. Questionaire that was used asked about four issues:

1) Course content and presentation method

2) Sound, image, and language syntax

3) Scene designing and

4) Course management

The original questionnaire can be found in Appendix III.

Answers were classified into five level of satisfactory including "Excellent", "Good", "Fairy Good", "Improve", "Reject" and then applied to score value 4, 3, 2, 1, 0 respectively. The scores at each level were calculated and analyzed for comparison in percent and mean value as shown in Table 6.1

The overall attitude in almost issue is rated at more than 70% except in sub-issue 'Background music' and 'Accuracy of the content'. These results indicate that most of attitude is in the range of "Good" to "Excellent". However, the mean values show a little bit defference as to be described in the following:

Issue 1, course content and presentation method is rated to "Good" or more, at the mean value more than 3 and no result in level "Improve" except issue "Accuracy of contents", "Validation of contents", "Interesting level" that are rated to "Improve" as 16%, 5%, 9% respectively. In two first issues, the results may be from:

- The mistake from the software presentation, for example, the image of %composition in Phase diagram is not correspond to the percent value of each component. This may be made the learners confused in the contents. However, all these mistakes have already been corrected.

- The mistake from the their own learners. Due to the user's involvement is required in some presentation, for example, click on or move pointer within the hot spot area (see more detail about hot spot in section 2.1.1.2) The relevant contents would not be shown unless the appropriate response is performed by the learners.

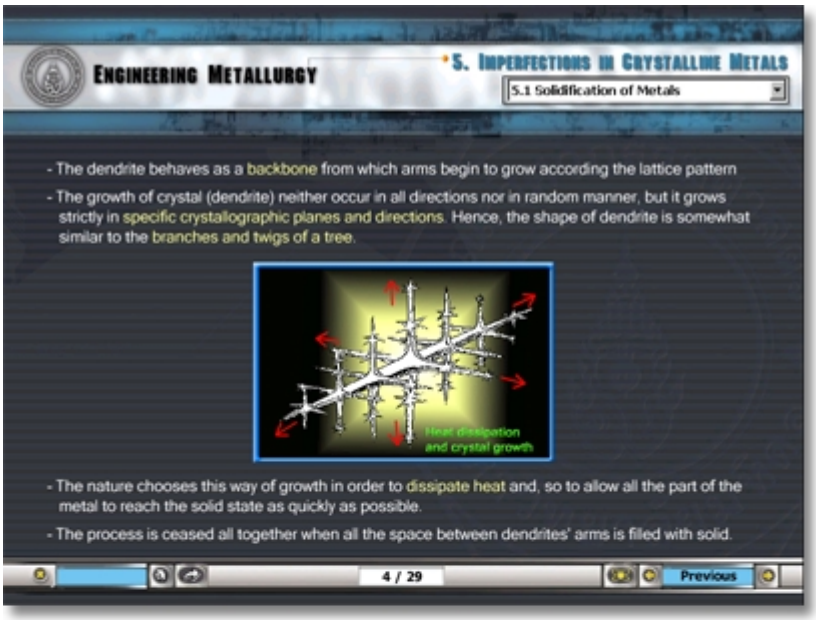
For sub-issue 'Interesting level' that is the overall attitude of this issue, 9% of learners rated on "Improve" that conform to results in previous sub-topics. Besides prior three issues, the attitude of 'Benefit from simulation' should be considered as the remarkly prominent of this software. The attitude on this sub-issue is "Good" and Mean = 3.19 without "Improve" or "Reject" opinions. These results indicate that the learners takes the full advantage from the simulation. Moreover, this opinion is supported by the result of issue 'Benefit from CAI software'.

Issue 2, Sound, Image and language syntax is rated to "Good" except 'Background music' with only Mean value = 2.06. Moreover, there are the opinion in "Improve" and "Reject" at 36% and 2% respectively. These results indicate that most of the learners do not pleased on this background music. The opinion from opened-end question shows that background music disturbs the learners' concentration. However, the voice for explanation is required by some learners. For the opinion about the image (sub-issue 2.1-2.3), the result has the same manner as 'Benefit from simulation'. This indicates that the learners also takes full advantage from the images in the EM-CAI.

Issue 3, Scene design is rated to "Good". However, the sub-issues "Font in program", "Beautiful and attractive" and "Overall opinion to program" are also rated to "Improve" at 5%, 2%, 5% respectively. The reason may be from:

- Font in program (5% improve) The opinions from opened-end questions imply that

the learners'screen resolution is not set to the proper value. This software is designed for running at screen resolution = 800X600. This resolution makes the learners see all components at proper size as shown in Figure 6.5a. However, the screen resolution may be 1024X768 as it often use in most today's computers that makes the learners see this software as a small window on the center of screen as shown in Figure 6.5b



(a)

(b)

Figure 6.5 Comparison the size of CAI software on screen resolution (a) 1024X768 and (b) 800X600

- Sub-issue 'Beautiful and attractive' will not be discussed because this opinion is subjective. However, it should be noted that there are only 2% of the learners (or 1 person) rated on "Improve"

- About sub-issue 'Overall opinion to program' that be almost rated on "Good". This conform with result in the other sub-issues in this section as discuss previously.

Issue 4, Course management is rated on "Good" except 'Convenience in using program' that the opinion in "Fairy Good" and "Improve" is 20% and 7% respectively. However, the opened-end question indicates that may be from the learners' mistake about the meaning of "convenience"

Besides the opinion from the closed-end questions, there were some points that might be improved in the opened-end question as the list below:

- User control for the simulations should be performed such as the button "Play and Pause" to start and stop the animation.

- The EM-CAI should be in Thai version or Thai dictionary program should be provided for English version.

- The voice for explanation should be added to the EM-CAI.

Table 6.1 The learner's attitude on CAI software obtained from questionnaire's answer of 46 persons. (the score summarized in five satisfied level as percent result)

Opinions	Level of attitude in percentage (%)					
	Mean	Excellent (4)	Good (3)	Fairy good (2)	Improve (1)	Reject (0)
1. course content and presentation method						
1.1 Contents cover objectives	3.25	32	61	7	-	-
1.2 Properly subtopic classification	3.16	25	66	9	-	-
1.3 Proper sequence of presentation	3.01	16	73	9	-	-
1.4 Accuracy of contents	2.55	14	41	30	16	-
1.5 Validation of contents	2.80	18	59	13	5	-
1.6 Benefit from simulation	3.19	30	57	14	-	-
1.7 Benefit from CAI software	2.80	9	66	23	-	-
1.8 Interesting level	2.88	27	45	18	9	-
2. Sound, Image and Language syntax						
2.1 Proper image	3.38	45	48	7	-	-
2.2 Size of image	3.27	36	59	2	2	-
2.3 Comprehensive of image	3.27	43	45	9	2	-
2.4 Syntax of contents	2.93	11	73	14	2	-
2.5 Music	2.06	16	20	23	36	2
3. Scene designing						
3.1 Font in program	2.88	18	55	23	5	-
3.2 Beautiful and attractive	3.12	32	50	16	2	-
3.3 Overall opinion to program	2.77	9	68	16	5	-
4. Course management						
4.1 Continuous of contents	3.04	11	82	7	-	-
4.2 Level user control	3.01	23	59	16	-	-
4.3Convenience in using program	2.82	25	45	20	7	-

6.2.2 t-test

The effectiveness of the EM-CAI is measured by comparing the difference in mean test scores between the control group and the CAI group as shown in Table 6.2

Table 6.2 The difference in mean scores between the control group and CAI group

Group	Sample size	Mean	S.D.
Control	49	8.90	1.79
CAI	46	9.57	1.82
t = 1.81 at a = 0.05			

The referenced t-value at $\alpha = 0.05$ from t-distribution table is 1.66. The calculated t-value in Table 6.2 is greater than the referenced t-value, therefore, there is a significant difference between the mean test score of the control group and CAI group at $\alpha = 0.05$.

6.2.3 Meta-analysis

The difference in mean test scores is re-analyzed by Meta-analysis method. In this research, Effect size is 0.37. This value is compared to the conventional value[14] in Table 5.1. The comparison shows that the level of effect size is small (value range = 0.20 - 0.49). It should be noted that the Effect size in this research is corresponding to many reports from the literature review[5] as shown in Table 6.3. These reports indicated that Effect size relates to the instructional level

Table 6.3 Comparison between the Effect size of Niemiec,et.al. and Kulik at different instructional level

Instructional level	Es (Niemiec and Walberg)	Es (Kulik)
Elementary school	0.46	0.37-0.40
High school	0.32	0.25
College / University	0.26	0.29

- Niemiec and Walberg(1987) reported that Effect size = 0.26 in the university level.

- Kulik(1994) reported that Effect size = 0.29 in the college level

In addition, Christmann, Badgett and Lucking reported that Effect size value relates to the course content as shown in Table 6.3.

Their experiment shows Effect size value is 0.64 for science subject that's higher than the Effect size in this research. However, this report don't state the level of science subject (Elementary school, High school or University) and based on Tallmadge suggestion that an Effect size of 0.25 or more is educationally significant, the Effect size 0.37 (in this research) can not be considered as too low value. Further studies should be performed in order to study the trend of Effect size in this subject.

Table 6.4 Comparison the Effect size of Christmann, et.al. at different course contents.

Course content	Effect size
English	-0.42
Math	0.18
Science	0.64