

EFFECT OF EXPERIMENTAL UTILITY IN CDIO COURSES: COMPARISON OF SIMULATED SOFTWARE PLATFORM TO SYNTHETIC HARDWARE TOOLKIT

**Xi Wu
Qiuyan Gai
Jin He
Yu Wang
Jianxi He
Mingyuan Xie**

Chengdu University of Information Technology P.R. China

ABSTRACT

According to the CDIO requirements, implementation of theoretical knowledge in the textbook through experimental exercises is one of the most important teaching modality in the CDIO courses. [4] Taking Digital Image Processing course of Chengdu University of Information Technology as research target, there are two categories of experimental utilities: software and hardware. Three subjects (image enhancement, image compression and color image processing) of this course were implemented using matlab 7.1 and image processing hardware toolkit (designed specifically in High speed Image Processing Centre of Chengdu University of Information Technology) [3] Two groups of students from 3rd year undergraduate students are compared through questionnaire investigation about teaching effects and the academic scores tested as the quantitative evaluation. This study demonstrates how students benefit through using software and hardware utilities to implement CDIO experiments, and to find out what is the respective advantage for these two methods in order to make further improvement on teaching.

KEYWORDS: CDIO, experimental utility, hardware, software

INTRODUCTION

In China, we are entering an era of teaching module reform of engineering courses; there are four universities involving in engineering education reform. [7] Chengdu University of Information Technology (CUIT) is one of them to conduct CDIO courses in 2008. As we entering this era of course reform, it is crucial to understand the goals of engineering education.[8] CDIO requires the graduates of engineering command of a vast of technical knowledge and possess personal, interpersonal, and system-building skills to function in teams and be ready for producing products and systems. [1]CDIO focus not only on the description of the knowledge, skills and attitudes to university education, but also on an indication of the level of proficiency expected of students including the improvement in

*8th International CDIO Conference 2012
July 1-4, Queensland University of Technology, Brisbane, Australia*

curricular and pedagogy or out-come assessment.

DIGITAL IMAGE PROCESSING COURSE AND ITS TEACHING METHOD

Digital image processing course of CUIT is about digital images and what can be done to digital images. Digital image can be stored into a computer, such as a discrete function of position and gray level. For example, the information of gray level at position in the image is contained into 2D case. It emphasizes general principles of image processing as well as specific applications. Several subjects are about image sampling and quantization, color, point operations, segmentation, morphological image processing, linear image filtering and correlation, image transforms, eigenimages, multi-resolution image processing, wavelets, noise reduction and restoration, feature extraction and recognition tasks, and image registration. There are three subjects of this course referring to image enhancement, image compression and color image processing. [5]The teaching method of this course is implemented through experimental exercise with software platform and hardware toolkit. Software utility uses designated platform and dataset to implement teaching knowledge. Software Matlab 7.1 is operated by students to operating data on computer. Matlab 7.1 is a high-level technical computing language and interactive environment used for algorithm development, data visualization, data analysis and numeric computation and offer a graphical user interface, tstool, enabling interactive visualization, editing and analysis of time series data. Hardware utilities are mostly composed of functional modules to implement individual theoretical problem. Synthetic integration of these modules including a part of self-designated devise makes hardware a good utility for improving abilities of practicing and team working, as well as the understanding of the theoretical problems. Image processing hardware toolkit which was designed specifically in high speed image processing centre of CUIT is used by students to operate in the class.

Comparison of two teaching methods

In order to find out the effects of two teaching methods during real teaching practice, the 168 undergraduate students of two classes in 3rd year studying an undergraduate digital image processing course at Chengdu University of Information Technology, China are investigated at the end of academic term.

Formulating the survey

The first step of formulating the survey was the construction of a paper survey. The graphic design of the survey is shown in figure 1.

The survey questionnaire was clear and concise and asked question desired the students' tendency for choosing experimental module in such a way that information was collected. Each respondent was asked to rate the reasons why to prefer the chosen teaching model.

Conducting the survey

The second step was conducting the survey. For each of those two models, we firstly asked 168 students to decide which kind of teaching module they would like to study at the first term, and then two groups were formed, the percentage of students using software and hardware is shown in table 1 as following. In the 2nd term, we asked them to swift their choice, the students who chose software utility would fall into the team of hardware utility. At the end of one academic year, the students were requested to fill up designed questionnaire as shown in figure 1 to compare the students' views on software and hardware usage.

RESULTS AND ANALYSIS

Students' distribution of using software and hardware

Before this course started, we introduced the arrangement, teaching method and teaching tool of software and hardware respectively for 168 students, and then let them to choose the way they like according to their own situation. Among 168 students, 45 of them are female, the others are male. The statistics of the results is shown in table1

Table1.
The Number of Students Using Software and Hardware in the 1st Term

Gender	Software	Hardware
Female	32	13
Male	50	73
total	82	86

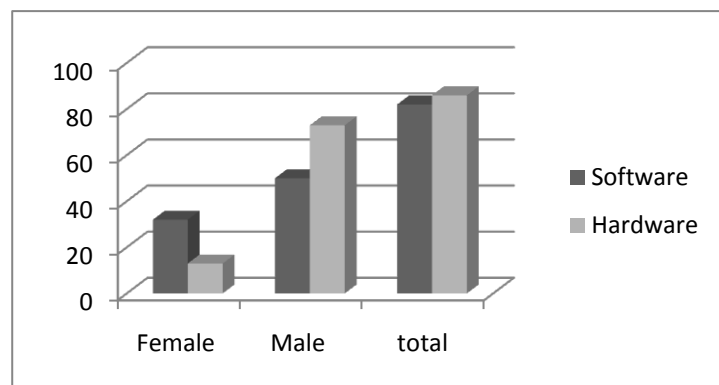


Figure2. The comparison of female and male students in using software and hardware in the 1st term

We can see from the table1 and figure 2 that the number of students who chose to use software utility is less than the number of students choosing hardware in the first term in which students can choose as their will. Among them, more female students than male students

chose software utility. After they finished the first term of academic year on studying the digital image processing course, they were asked to choose different experimental utility. The distribution of the students is shown as table 2 and figure3

Table2.
The Number of Students Using Software and Hardware in the 2nd Term

Gender	Software	Hardware
Female	13	32
Male	73	50
total	86	82

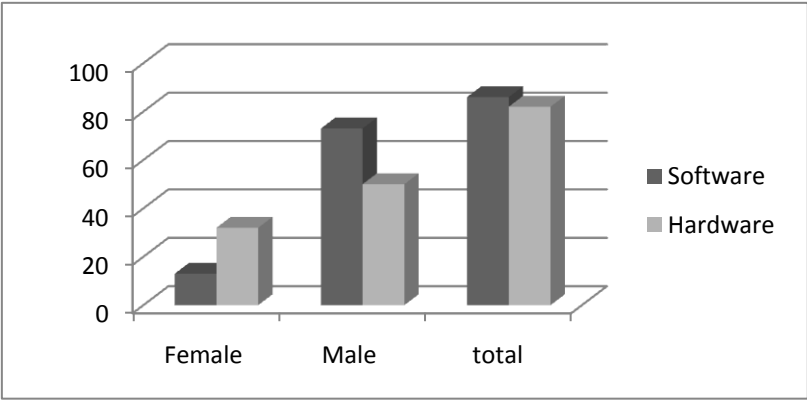
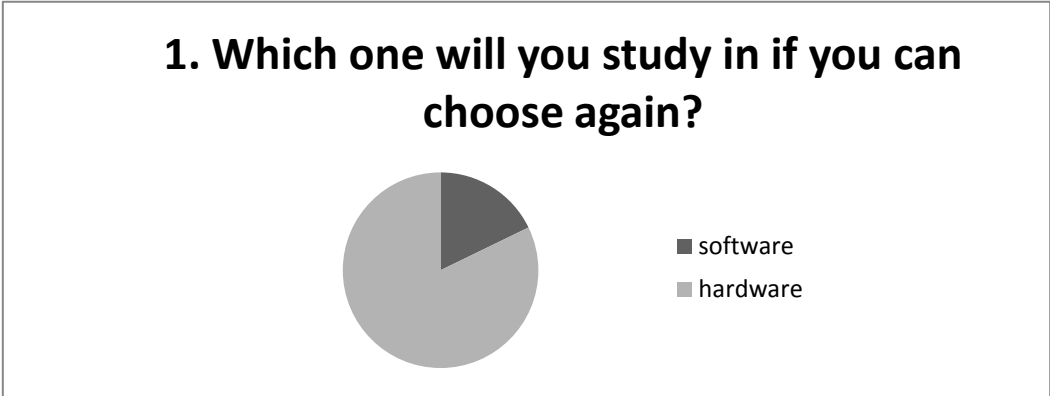


Figure3. The comparison of female and male students in using software and hardware in the 2nd term Software is shown in first row, while hardware is shown in second row

The students' report on questionnaire

168 students were investigated to answer questions from designed questionnaire at the time of course completion. Five questions were designed about the views on software and hardware to those students who had used software utility and hardware utility in experimental course. By doing this, it will be objective for them to have full comprehension about those two utilities. The results of the investigation are shown as below:



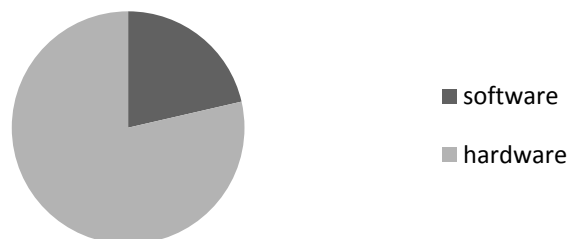
2. Which one is easier to understand theoretical knowledge?



3. Is there big difference between software and hardware?



4. Which one do you think is more interesting?



5. Which one will enhance your good ability of practicing and team working?



As the results shown as above, the students who had experience of using two utilities finished the questionnaire, it is clear to see that hardware utility has more advantage than software utility, which mainly manifests into the interest and the benefit of practicing and team working. Most students prefer to use hardware utility to learn digital image processing course. While, software utility has its own advantage that is easy for understanding the theoretical knowledge.

The comparison of students' score in two experimental modules

According to the standard of teaching, we tested those students on their performance with the same examination paper at the end of each term. The mean score of two utilities for each term is shown in table 3.

Table 3
The Mean Score for Each Term

Term	Software experimental class	Hardware experimental class
1 st term	86.7	75
2 nd term	92.6	90.8

From the comparison of mean score, we can see clearly that the students can usually get higher score by using software utility, which accords with that software is easier to understand the theoretical knowledge. In the first term, the students who used software utility got higher score than the students who used hardware utility, while in the second term, we asked two groups of students shifted their choices, so the students who used software utility in second term is the students who used hardware utility in first term. We can see that the mean score of software experimental class in 2nd term is 92.6 that is even higher than the mean score in first term 86.7. The mean score of hardware experimental class in 2nd term is 90.8 that is higher than the mean score in first term 75.

SUMMARY AND CONCLUSION

Our conclusions and recommendations divide into three categories: the advantages of hardware utility, the advantages of software utility and the improvements of this course accord with CDIO syllabus.

The advantage of software utility

Based on the investigation, we found out that the software utility is good for students to understand the theoretical knowledge. Students can operate matlab 7.1 to see how the theoretical knowledge applied into program making and processing those digital images directly. [10]

The advantage of hardware utility

The students use image processing hardware toolkit which was designed specifically in high speed image processing center of Chengdu University of Information Technology to know how to operate the utility based on the theoretical learning.

The further improvement of this course accord with CDIO syllabus

Based on the investigation and analysis of the collected data, we see that the advantage of software and hardware utilities during the implement of digital image processing course. Firstly, from the questionnaire and the score comparison of students, hardware has many advantages in operating utility, team spirit building and interest in operation. But the students got lower score than the students using hardware utility. That means using software utility is easier for students to command better idea about theoretical knowledge, while hardware utility has direct view about how to operate the utility, but it is lack of specific understanding about the theoretical knowledge. [5] Practically, it is not easy for us to test the operation performance for students, so most of the parts in examination are going to test ability of commanding theoretical knowledge from textbooks. This is one of the place we need to do further improvement on practical test for students' performance. Secondly, from the results of comparison between students' score in different teaching modules, we can conclude that the combination of software and hardware will be better than single teaching module in software or hardware. The difference score in two terms clearly showed that hardware and software could be complementary for each other. [7] So the reform of course according to CDIO syllabus should be exerted from the feedback of students in order to realize the requirements of four principles in conceive, design, implement and operate.

APPENDIX

Student Course Evaluation Questionnaire

(To be filled by each student at the time of course completion)

Department: _____ course: _____

Year of study: _____ semester: _____

Please give us your views so that Course quality can be improved. You are encouraged to be frank and constructive in your comments.

1. Which one will you study in if you can choose again?
 - a. Software
 - b. Hardware
2. Which one is easier to understand theoretical knowledge?
 - a. Software
 - b. Hardware
3. Is there big difference between software and hardware?
 - a. Yes
 - b. No
 - c. I don't know
4. Which one do you think is more interesting?
 - a. Software
 - b. Hardware
5. Which one will enhance you good ability of practicing and team working?
 - a. Software
 - b. Hardware

THNAK YOU

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