# Enhancing ICT Skills Learning through Peer Learning: Perspectives of Learning Style and Gender

Li-Chun Wang & Ming-Puu Chen

***Abstract*****—**In the present study, peer learning was implemented to enhance secondary school learners' learning process and performance in a collaborative ICT project. There were 139 8th graders, 72 males and 67 females, participated in the experimental instruction. Participants' learning styles were identified based on the perspective of Verbal-Imaginal information processing. Peer learning process was implemented to support and enahnce the collaborative learning process. The results revealed that (a) the female learners achieved higher comprehension and application performance than the males, (b) the female learners also perceived the employed peer learning to be more "compensation" than the male learners, (c) the "enhancement" effect of peer learning on learning style was found for the imaginal learners on comprehension performance, (d) the "compensation" effect of peer learning on learning style was found for the verbalizer on application performance, and (e) the gender difference effect was significant on learners' performance, learning progress and attitudes.

***Keywords*****—**ICT in schools, Peer Learning, Individual differences, Learning style

## I. Introduction

In the digital era, information fluency has become one of the most important capabilities for students [1]. Information fluency implied that students should be able to apply existing knowledge to generate new ideas, develop innovative products, or make use of technology as cognitive or productivity tools. From perspective of social constructivism, the function of individual differences on skills, aptitudes and learning preferences could have impact for the application of technology in classroom settings. Learners' learning styles affect the preferences of information process and prior knowledge affect the propositional network of the long-term memory. Previous studies have confirmed that matching types of instruction with learners' stronger learning styles could enhance learners' information and communication technology (ICT) skills and motivation [2], [3], [4]. Kolb also suggested that compensation can help learners overcome weakness in their cognitive styles and develop a more integrated approach to learning [5]. However, how can learning activities make effect to compensate for learners' weaker learning style remains an unsolved issue?

Based on the enhancement/compensation perspective, the present study employed a collaborative project-based learning to help learners become aware of their learning preference, reflect on their learning progress, and promote their performance in ICT learning. Therefore, the effects of learning style and gender on secondary school learners' collaborative project performance in an ICT course can be examined thoroughly.

## II. Literature and Related Works

The emerging technologies contribute learners to communicate, work collaboratively and develop creativity products effectively. In the digital age, information is commonly delivered by multiple-representations. How to cultivate learners to select informed information, develop innovative products and evaluate learning product based on critical thinking skills as common issues of educators? To achieve these goals, teachers who plan and design technology-supported learning environments and experiences for their students must be considerate of information-processing variables, background variables, learning objectives, the attributions of technology, and the assessment of content comprehension and appropriateness of technology used.

In junior high technology course, learners play as active, silence or passive participants. Individual differences, such as prior knowledge, learning style and gender can have impact on skills, aptitudes and learning preferences for the application of technology in educational practice. Prior knowledge consists of propositional networks in the long-term memory and is a prerequisite to the learning of new skills. Learning styles are the mental processes and instructional settings a learner apply learning strategies to perform specific tasks [6]. It has been concluded that the verbalizers learn best from textual representation, and that the imaginers learn best form graphical representation. Literatures have confirmed that matching learners' stronger learning styles with instructional strategies will result in enhanced performance, higher level of satisfaction and motivation in the learners [2], [3], [4]. Furthermore, it was suggested that gender differences influenced learners' computer performance and computer attitudes since males got higher scores in technology-based courses, performed better in the practical tasks, showed more interests in using and learning about computers, and attributed

Manuscript received Feb 14, 2008; Revised received September 7, 2008.

L. C. Wang is with the Graduate Institute of Information and Computer Education, National Taiwan Normal University, TAIWAN (e-mail: cct101wang@gmail.com).

M. P. Chen is with the Graduate Institute of Information and Computer Education, National Taiwan Normal University, Taipei, TAIWAN (corresponding author, phone: +886-2-2362-2841 ext.21; fax: +886-2-2351-2772; e-mail: mpchen@ntnu.edu.tw).

any success in technology is ability [7], [8], [9]. Conversely, females were reported to be fear of using computers, had lower confidence in computer aptitudes, but performed better in academic tests, attracted to computer courses that emphasize social issues and computer applications [7], [9], [10], [11]. Similarly, some studies suggested that females benefit from their tame gender characteristics to achieve higher performance [4]. And female attributed their success to work hard instead of ability [9]. To sum up, research findings on gender differences and learning preferences remain inconclusive. The expected positive impact on learning performance and attitudes relies on considerate design that matches learners' individual needs and characteristics. Therefore, Kolb suggested that compensation designs can help learners overcome weakness in their cognitive styles and develop a more integrated approach to learning [5].

Peer learning can be defined as the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions [12]. While, peer assessment is a process whereby groups of individuals rate their peers and provided feedback by pre-defined marking criteria [13]. During the process of discussing feedback could help learners incorporate new information into prior knowledge and promote meaningful learning. Integrating ICT into peer assessment used online databases to record background information, each phase of production, feedback and performance. Learners could review their evolution of learning progress from the e-portfolio. Therefore, the goals of peer assessment can be achieved through the cycle of "peer learning ➔ peering assessment ➔ peer feedback" to help learners reflect and modify their mental models, and facilitate achieving ZPD (zone of proximal development). From the view of social construction theory and social learning theory, with the help of the peer learning process, learners can immerse in "learning by teaching" and carry out collaborative learning in the learning community successfully. Due to the individual differences that verbalizers prefer textual representations and imaginers prefer graphical representations, the deliberate design and considerations of learners' learning styles during the peer learning process would promote learners being aware of their learning preference, compensate learners' inability or enhance their stronger learning preference.

The role of technology in learning as thinking tools, communication media, environment, partner and scaffold [14] that learners use technology as vehicle for interacting with each other, sharing ideas, applying their insights to real-life problem, and by the way of expert guidance or collaboration with peer extending learners' ability. Integrating pedagogy, content and technology into educational practice, learners used ICT to represent comprehded knowledge based on their learning preference in peer tutoring context. The helper could consolidation acquired knowledge by demonstrating project. Meanwhile, the helped learners could aware their learning preference and compensation acquired knowledge by modeling project. Therefore, combining peer assessment with collaborative project could promote learners' self-awareness, reflective and metacognition understanding about their learning process in technology-supported learning environment [12], [15]. Literature reviewed also confirmed that students held positive attitudes toward the use of peer assessment activities, and male students had more positive attitudes toward online peer assessment than female [15].

## III. Methods

The present study examined the effects of individual differences on secondary school learners' project performance, learning progress and attitude in an ICT course. A 5-week group-based collaborative multimedia project was employed. An example-theory-practice learning approach and peer assessment were implemented in the collaborative project to facilitate participant's multimedia skills learning and production performance. The participants were 139 secondary school learners, 72 male and 67 female 8th graders aged from 15 to 16, who were taking the information technology courses taught by the same teacher. Participants' learning style was identified based on the perspective of Verbal-Imaginal information processing.

A collaborative ICT project was implemented in the present study in order to enhance the stronger learning style and/or compensate the weaker learning style by peer learning. It consisted of five sessions including creative scenario, background design, photo design, context design, project demonstrate and conclusions. The process and content of the collaborative learning process is shown as Table 1.

Table 1 Collaborative learning process

| Sessions | Topics | Project Activity | Time |
|---|---|---|---|
| 1 | Description of group activity | Each group consisted of 3-4 learners by heterogeneity<br>Description of task goals and criteria of peer assessment | 10 |
| | Project phase 1<br>- Creative scenario | Discuss the project scenario<br>Record learning progress in worksheet | 15 |
| 2 | Project phase 2<br>– Background design | Collaborative project task 2<br>Record learning progress in worksheet<br>**Online peer assessment** (scored, attribution) | 30<br><br>15 |
| 3 | Project phase 3<br>– Photo design | **Peer feedback**<br>**Revised** project task 2 by peer feedback<br>Collaborative project task 3<br>Record learning progress in worksheet | 10<br><br>35 |
| 4 | Project phase 4<br>– Context design | Collaborative project task 4<br>Record learning progress in worksheet<br>**Online peer assessment** (scored, attribution) | 30<br><br>15 |
| 5 | Project phase 5<br>– Demonstration | **Peer feedback**<br>**Revised** project task 3,4 by peer feedback<br>Collaborative project task 5<br>Record learning progress in worksheet<br>**Online peer assessment** (scored, attribution) | 10<br>20<br><br>15 |
| 6 | Conclusions | **Peer feedback**<br>Announcement final project score of each group and individuals | 10 |

Learners' self-assessment and peer assessment were conducted between sessions in order to promote the comprehension of knowledge and compensate for inability in knowledge construction, knowledge clarification, knowledge consolidation and knowledge application. The effect of peer learning is shown as Figure1. Learners construct content knowledge by peer learning. During peer assessment, they discuss the peer production based on pre-defined criteria to clarify comprehended knowledge and negotiate feedback to consolidate knowledge.

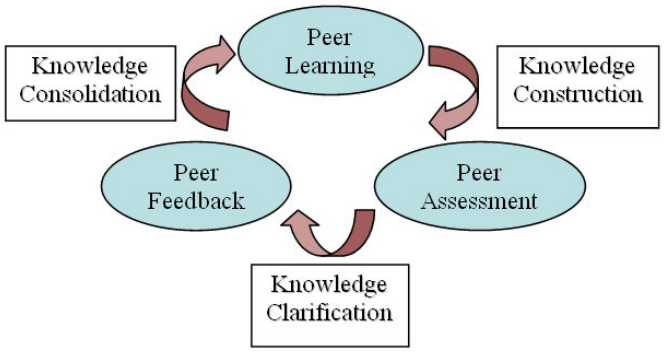


Fig. 1 The effects of peer learning

The group-based collaborative tasks were employed to facilitate individuals to communicate and tutor each other, and thus the tasks can be finished in a collaborative way. The project process were collaborative project work, record learning progress, self/peer assessment, peer feedback and modify project product. Self-assessment of the learning progress helped learners monitor the learning progress, notice about necessary modifications for the project, and be guided toward the learning goals. Peer assessment accompanied peer feedback helped learners clarify misconception and develop critical thinking. Through the modification of project outcomes learners were facilitated to develop metacognitive skills and apply suitable learning strategies for completing the project. The framework of peer assessment in the employed technology-supported learning environment is shown as Figure 2.

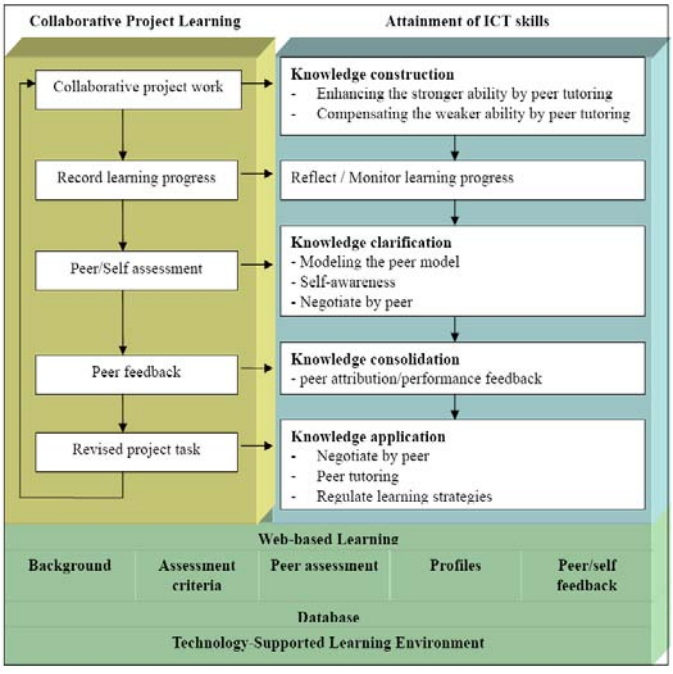


Fig. 2 The framework of peer assessment

There were 6 research instruments utilized in the present study, including an online prior knowledge assessment, an online learning style instrument, an online peer assessment scale, a collaborative project worksheet, an online attitude questionnaire, and a performance instrument. The research instruments are described as follows.

The online prior knowledge instrument was conducted to access learners' prerequisite knowledge of the learning content. The prior knowledge scale consisted of two aspects of subscales, including the comprehension subscale and the application subscale. Totally, there were 20 items in the prior knowledge scale. The overall reliability coefficient of the prior knowledge scale was .90 (Cronbach's alpha). Learners were given the results on-line immediately after the test.

The learning style instrument examined learners' stronger and weaker learning styles. The scale was developed by More [5] and consisted of 32 statements. The learners were asked to rate themselves according to how well the statements describe them on a 5-point Likert-type scale. The response options of the scale ranged from 1 to 5 standing for (1) almost never, (2) seldom, (3) sometimes, (4) usually, and (5) almost always, respectively. The overall reliability coefficient of the learning style scale was .84 (Cronbach's alpha). The scale categorized the learning styles by Verbal-Imaginal. It was hypothesized that the verbal learners learn better from highly verbal explanations such as dictionary style definitions, rely more on words and labels, use verbal regulation of behaviors more effectively, and code concepts verbally. Similarly, the imaginal learners were hypothesized to learn better from images, symbols and diagrams, remember better when coding imaginally, and use images to regulate behaviors. A learner's stronger learning style was identified from the higher score in the two dimensions of Imaginal and Verbal. Then, the top 38% participants of a learning style were categorized to represent the group of stronger learning style, and the last 38% participants with weaker learning style were selected to represent the group of weaker learning style. The others were categorized as the no-significant learners. As a result, 51 verbalizers and 47 imaginers were identified as the sample for the present study.

The online peer assessment scale was employed to evaluate the progressive performance by peers and the tutor in the final 15 minutes of the second, fourth and fifth sessions. Participants need to score a specific aspect of the project and provide positive feedbacks for peer learners. As shown in Figure 3, the scoring rubrics employed specific criteria to evaluate peer learners along with feedbacks. Then, the groups mean scores from peer assessment were given as a group's score of progressive performance.


Fig. 3 A sample rubric of the online peer assessment scale

The collaborative project worksheet was employed to guide the learners throughout the project phases and help learners' record how they progress through the project phases and collaborate with team members. Therefore, learners' learning progress and collaborative work were recorded through the use of the project worksheet.

An online attitude questionnaire was conducted to examine learners' perception of enhancement, perception of compensation, and motivation toward the collaborative project. Learners were asked to rate themselves on a 5-point Likert-type scale with response options ranged from 1 (strongly disagree) to 5 (strongly agree). The reliability coefficient of attitude questionnaire was .85 (Cronbach's alpha).

Finally, a performance instrument was conducted to examine learners' performance of the collaborative project. The target knowledge and number of items of the performance instrument were the same as the prior knowledge instrument. The overall reliability coefficient of the scale was .92 (Cronbach's alpha).

## IV. Findings

Multivariate analyses of variance (MANOVA) were performed to investigate the effects of learning style and gender on participants' project comprehension and application performance, and attitude. ANOVA were performed to investigate the effects of learning style and gender on participants' learning progress. Spearman rank-order correlation was conducted to evaluate the consistency between peer assessment and expert assessment. The significance level was set to .05 for the study.

The mean scores of learning style and gender on project comprehension and application performance are shown in Table 2. The imaginal learning style group scored higher than the verbal group and the female group scored higher than the male group both in the performance test (comprehension performance) and project products (application performance).

Table 2 The mean scores of learning style and gender groups on comprehension and application performance

| Independent Variables | Aspects | M | SD | N |
|---|---|---|---|---|
| 1.Comprehension Performance | | | | |
| Learning Styles | Verbal | 60.87 | 20.763 | 52 |
| | Imaginal | **70.85** | 16.720 | 53 |
| | Total | 65.91 | 18.722 | 105 |
| Gender | Male | 61.40 | 21.666 | 57 |
| | Female | **71.25** | 14.822 | 48 |
| | Total | 65.90 | 19.399 | 105 |
| 2.Application Performance | | | | |
| Learning Styles | Verbal | 19.33 | 6.336 | 52 |
| | Imaginal | **21.32** | 5.424 | 53 |
| | Total | 20.33 | 5.88 | 105 |
| Gender | Male | 18.79 | 7.333 | 57 |
| | Female | **22.17** | 2.816 | 48 |
| | Total | 20.33 | 5.950 | 105 |

The MANOVA summary of learning styles and gender on comprehension and application performance is shown as Table 3. All of the 2-way interactions of learning style and gender were not significant. The main effects of learning style was significant in the comprehension performance ($F_{(1,101)}$ =4.738, $p$ = .032), but not significant in application performance($F_{(1,101)}$ =1.023, $p$ = .314). Meanwhile, the main effects of gender were significant in the comprehension ($F_{(1,101)}$ =4.084, $p$ = .046) and application ($F_{(1,101)}$ =6.916, $p$ = .010) performance. The results indicated that learning style and gender affected participants' project performance significantly. In other words, on the project comprehension performance, the imaginers ($M$=70.85) and female ($M$=71.25) outperformed the verbalizers ($M$ =60.87) and male ($M$ =61.40). On the project application performance, the female ($M$ =22.17) outperformed the male ($M$ =18.79). There is no significant difference between verbalizers and imaginers in project application performance.

Table 3 ANOVA summary of learning styles and gender on comprehension and application performance

| Source of Variation | Aspects | SS | df | MS | F | Sig. |
|---|---|---|---|---|---|---|
| Learning Styles×Gender | Comprehension | 135.568 | 1 | 135.568 | .392 | .533 |
| | Application | .933 | 1 | .933 | .028 | .867 |
| Learning Styles | Comprehension | 1638.026 | 1 | 1638.026 | 4.738 | **.032** |
| | Application | 33.903 | 1 | 33.903 | 1.023 | .314 |
| Gender | Comprehension | 1412.046 | 1 | 1412.046 | 4.084 | **.046** |
| | Application | 229.230 | 1 | 229.230 | 6.916 | **.010** |
| Error | Comprehension | 34918.403 | 101 | 345.727 | | |
| | Application | 3347.754 | 101 | 33.146 | | |

Spearman rank-order correlation was conducted to evaluate the consistency between peer assessment and expert assessment. The correlation coefficients for the 3 phases of peer assessment and overall coefficient were significant (phase 1: $r$ = .674; phase 2: $r$ = .668; phase 3: $r$ = .665; total: $r$ = .751). The results indicated that the reliability between peer assessment and expert assessment was consist and acceptable.

The mean scores of learning style and gender on learning progress are shown in Table 4. The imaginal learning style group scored higher than the verbal group and the female group scored higher than the male group in the monitoring of learning progress.

Table 4 The mean scores of learning styles and gender groups on learning progress

| Independent Variables | Aspects | M | SD | N |
|---|---|---|---|---|
| Learning Styles | Verbal | 6.92 | 2.300 | 52 |
| | Imaginal | **7.36** | 1.962 | 53 |
| | Total | 7.14 | 2.129 | 105 |
| Gender | Male | 6.58 | 2.521 | 57 |
| | Female | **7.81** | 1.299 | 48 |
| | Total | 7.14 | 2.137 | 105 |

The ANOVA summary of learning styles and gender on learning progress is shown as Table 5. All of the 2-way interactions of learning style and gender were not significant. The main effects of gender was significant in learning

progress ($F_{(1,101)}$ =8.028, $p$ = .006), but the main effects of learning style was not significant ($F_{(1,101)}$ =.107, $p$ = .744). The results indicated that gender difference affected learning progress. In other words, the female ($M$ =7.81) got better learning progress than the male ($M$=6.58).

Table 5 The ANOVA summary of learning styles and gender on learning progress

| Source of Variation | SS | df | MS | F | Sig. |
|---|---|---|---|---|---|
| Learning Styles×Gender | .339 | 1 | .339 | .079 | .779 |
| Learning Styles | .460 | 1 | .460 | .107 | .744 |
| Gender | 34.537 | 1 | 34.537 | 8.028 | **.006** |
| Error | 434.482 | 101 | 4.302 | | |

Table 6 The attitude mean scores of learning style and gender groups

| Independent Variables | Aspects | M | SD | N |
|---|---|---|---|---|
| 1.Perception toward Enhancement | | | | |
| Learning Styles | Verbal | 10.04 | 2.856 | 52 |
| | Imaginal | 10.09 | 3.499 | 53 |
| | Total | 10.07 | 3.181 | 105 |
| Gender | Male | 9.74 | 3.538 | 57 |
| | Female | 10.46 | 2.681 | 48 |
| | Total | 10.07 | 3.181 | 105 |
| 2.Perception toward Compensation | | | | |
| Learning Styles | Verbal | 10.12 | 3.123 | 52 |
| | Imaginal | 10.23 | 3.309 | 53 |
| | Total | 10.18 | 3.217 | 105 |
| Gender | Male | 9.33 | 3.313 | 57 |
| | Female | 11.17 | 2.785 | 48 |
| | Total | 10.17 | 3.203 | 105 |
| 3.Perception toward Motivation | | | | |
| Learning Styles | Verbal | 9.81 | 2.870 | 52 |
| | Imaginal | 10.57 | 2.832 | 53 |
| | Total | 10.19 | 2.851 | 105 |
| Gender | Male | 9.68 | 3.036 | 57 |
| | Female | 10.79 | 2.543 | 48 |
| | Total | 10.19 | 2.863 | 105 |

The attitude mean scores of learning style and gender groups are shown in Table 6. Participants showed positive attitudes toward the enhancement, compensation, and motivation. As for participants' perception toward the assertion that learning style enhances learning, the imaginer ($M$ =10.09) scored higher than the verbalizer ($M$ =10.04) and the female group ($M$ =10.46) scored slightly higher than the male group ($M$ =9.74). On perception toward compensation aspect, the verbalizer ($M$ =10.12) scored higher than the imaginer ($M$ =10.23) and the female group ($M$ =11.17) scored higher than the male group ($M$ =9.33). Furthermore, on the motivation aspect, the imaginer ($M$ =10.57) scored higher than the verbalizer ($M$ =9.81) and the female group ($M$ =10.79) also scored higher than the male group ($M$ =9.68). The difference of participants' attitudes between groups was further examined by means of MANOVA analysis.

The MANOVA summary of learning style and gender on attitude is shown in Table 7. All of the 2-way interactions were not significant. The main effects of gender on perception of compensation ($F_{(1,101)}$ =7.919, $p$ = .081) was significant and indicated that female learners ($M$ =11.17) perceived higher level of compensation effect of learning style than the male($M$ =9.33). The results indicated that participants' held the same positive toward enhancement, compensation, and motivation no matter the stronger learning style their possessed. Similarly, male and female learners revealed the same positive perceptions of enhancement and motivation. In addition, male and female learners both perceived the compensation aspect positively, but female learners possessed higher degree attitude toward the compensation aspect than males.

Table 7 The MANOVA summary of learning style and gender on attitude aspects

| Source of Variation | Aspect | SS | df | MS | F | Sig. |
|---|---|---|---|---|---|---|
| Learning Styles×Gender | Enhancement | .075 | 1 | .075 | .007 | .932 |
| | Compensation | 5.762 | 1 | 5.762 | .600 | .440 |
| | Motivation | 8.332 | 1 | 8.332 | 1.045 | .309 |
| Learning Styles | Enhancement | .512 | 1 | .512 | .050 | .824 |
| | Compensation | 4.655 | 1 | 4.655 | .485 | .488 |
| | Motivation | 4.820 | 1 | 4.820 | .604 | .439 |
| Gender | Enhancement | 14.032 | 1 | 14.032 | 1.365 | .245 |
| | Compensation | 93.330 | 1 | 93.330 | 9.719 | **.002** |
| | Motivation | 24.723 | 1 | 24.723 | 3.100 | .081 |
| Error | Enhancement | 1038.417 | 101 | 10.281 | | |
| | Compensation | 969.886 | 101 | 9.603 | | |
| | Motivation | 805.616 | 101 | 7.976 | | |

The findings of this study can be summarized as shown in Table 8. For the learning performance, gender difference and the effect of learning style was found. The effect of gender difference on learning performance was opposite to Chen [7] and Demirbas and Demirkan [8] that female learners got higher scores in technology-based course. As for the attitude aspect, female and male learners almost got the same perception toward learning activity. However, an interesting phenomenon that the female learners revealed higher degree perception of compensation effect was found. These signified that female perceived more helpful and conceptual understanding from collaborative peer discussion, and get more in-depth comprehension from peer tutoring. By thus, female got higher comprehension performance and application performance, and monitored better on learning progress.

After learning, the imaginers outperformed the verbalizers on comprehension performance. That is to say, the imaginers benefited more from the given learning activity than the verbalizers. Therefore, the enhancement effect can be concluded for the imaginers. The effect can be inferred as contributed by the collaborative learning process that facilitate individuals to communicate and tutor each other, monitor learning progress, notice about necessary adjustment in employed strategies. Besides, the abstract characteristic of the ICT domain knowledge usually requires learners to construct multi-representations in they mind in order to comprehend the given content. Thus, the imaginal learners could get more proficient in constructing multi-representations than the verbal learners. According to the perspective of multimedia learning theory, the "enhancement" result of the present study is consistent with the perspective of "matching learning styles with instructional presentational strategies is significant in enhancing learners' learning performance". For verbal

learners, they also benefited from collaborative project to compensate their inability by peer tutor. These revealed on learners' application performance that after the process of collaborative project work, record learning progress, self/peer assessment, peer feedback and modify project product, the verbaliers achieved the same skill level and learning progress with the imaginers. This result verified the perspective of compensation that "matching weaker learning styles with learning strategies to compensate learners' inability and promote learners aware their learning preference by peer assessment.

Table 8 Summary of the effects of learning style and gender on performance, learning progress and attitude

| Aspects | Sub-aspects | After Learning |
|---|---|---|
| Performance | Comprehension | **Female**>Male |
| | | **Imaginer**>Verbalizer |
| | Application | **Female**>Male |
| | | Verbalizer=Imaginer |
| Learning Progress | | **Female**>Male |
| | | Verbalizer=Imaginer |
| Attitude | Enhancement | Female=Male |
| | | Verbalizer=Imaginer |
| | Compensation | **Female**>Male |
| | | Verbalizer=Imaginer |
| | Motivation | Female=Male |
| | | Verbalizer=Imaginer |

## V. Conclusion

The present study examined the perspective of compensation and enhancement that when learning strategies matched with learners' stronger learning style learners' performance and motivation will be enhanced, and when learning strategies matches with learners' weaker learning styles learners' ICT skills will be compensated. Based on the process of peer learning, peer assessment and peer feedback, various learners of learning styles could achieve the same level of ICT skills and learning progress. The employed example-theory-practice learning approach revealed to be helpful for teachers to demonstrate examples to serve as a model for learners, foster learners' comprehension, and enhance learning performance through practicing the comprehended knowledge. The present study concluded that (a) the female learners achieved higher comprehension and application performance than the males, (b) the female learners also perceived the employed peer learning to be more "compensation" than the males, (c) the "enhancement" effect of peer learning on learning style was found for the imaginer on comprehension performance, (d) the "compensation" effect of peer learning on learning style was found for the verbalizer on application performance, and (e) finally, the gender difference effect was found on ICT learning performance, learning progress and attitudes.

## Acknowledgment

This study was sponsored by the National Science Council of Taiwan, project number: NSC 96-2629-S-003-001.

## References

[1] International Society for Technology in Education (ISTE) (2007). *National educational technology standards for students.* Retrieved October 5, 2007, from http://cnets.iste.org/students/pdf/NETS_for_Students_2007.pdf

[2] Dunn, R. S., & Dunn, K. J. (1979). Learning styles/teaching styles: Should they…can they… be matched? *Educational Leadership, 36(*4), 238-244.

[3] Renninger, K. A., & Snyder, S. S. (1983). Effects of cognitive style on perceived satisfaction and performance among students and teachers. *Journal of Educational Psychology, 75*(5), 668-676.

[4] Wang, L. C., & Chen, M. P. (2008). Enhancing ICT learning by matching type of instruction and individual differences. *Proceedings of the Society for Information Technology and Teacher Education International Conference*, pp. 2272-2278. March 3-6, 2008, Las Vegas, Nevada, USA.

[5] Kolb, D. A. (1984). *Experimental learning*. Englewood Cliffs NJ: Prentice-Hall.

[6] More, A. J. (1993). *Learning styles and the classroom*. British Columbia University, Vancouver. (ERICDocument Reproduction Service No. ED368479)

[7] Chen, S. Y. (2005). Evaluating the learning effectiveness of using web-based instruction: An individual differences approach. *International Journal of Information and Communication Technology Education*, *1*(1), 69-82.

[8] Demirbas, O. O., & Demirkan, H. (2007). Learning styles of design students and the relationships of academic performance and gender in design education. *Learning and Instruction*, *17*, 345-359.

[9] Cooper, J. (2006). The digital divide: The special case of gender. *Journal of Computer Assisted Learning*, *22*, 320-334.

[10] Henwood, F., From the woman question in technology to the technology question in feminism: Rethinking gender equality in IT education, *The European Journal of Women's Studies*, 7, (2), 209-227, 2000.

[11] Beyer, S., Rynes, K., Perrault, J., Hay, K., & Haller, S. (2003). Gender difference in computer science students. *SIGCSE*, pp. 49-53. Feburary 19-23, 2003, Reno, Nevada, USA.

[12] Topping, K. J. (2005). Trends in peer learning. *Educational Psychology*, *25*(6), 631-645.

[13] Falchikov, N. (1995). Peer feedback marking: Developing peer assessment. *Innovations in Education and Teaching International, 32*, 175–187.

[14] Goldman-Segall, R., & Maxwell, J.W. (2003). Computers, the Internet, and new media for learning. In W. M. Reynolds & G. E. Miller (Eds.), *Handbook of Psychology, vol. 7: Educational Psychology* (pp. 393-427). New York: JohnWiley & Sons.

[15] Wen, M. L., & Tsai, C. C. (2006). University students' perceptions of and attitudes toward (online) peer assessment. *Higher Education*, *51*, 27-44.