International Journal of Business, Human and Social Sciences
ISSN: 2517-9411
Vol:8, No:5, 2014

The Effectiveness of ICT-Assisted PBL on College-Level Nano Knowledge and Learning Skills

Ya-Ting Carolyn Yang, Ping-Han Cheng, Shi-Hui Gilbert Chang, Terry Yuan-Fang Chen, Chih-Chieh Li

***Abstract*—**Nanotechnology is widely applied in various areas so professionals in the related fields have to know more than nano knowledge. In the study, we focus on adopting ICT-assisted PBL in college general education to foster professionals who possess multiple abilities. The research adopted a pretest and posttest quasi-experimental design. The control group received traditional instruction, and the experimental group received ICT-assisted PBL instruction. Descriptive statistics will be used to describe the means, standard deviations, and adjusted means for the tests between the two groups. Next, analysis of covariance (ANCOVA) will be used to compare the final results of the two research groups after 6 weeks of instruction. Statistics gathered in the end of the research can be used to make contrasts. Therefore, we will see how different teaching strategies can improve students' understanding about nanotechnology and learning skills.

***Keywords*—**Nanotechnology, science education, project-based learning, information and communication technology.

I. Introduction

NANOTECHNOLOGY has been a promising field for research. Hence, graduate-level programs were established to foster professional researchers. However, with the development of Nano Industry, research experts in this field are no longer in demand. Instead, managers who have know-how on nano products and Industry planning are highly sought after and have become the important resources in nano industry [1]. For this reason, nanotechnology-related courses are offered not only in College of Science, but in General Education Center and College of Business and Management, focusing on the application of nanotechnology. By doing so, more and more professionals in business management area have further understanding of nano industry, meeting the demand of the future development.

From the perspective of business management, product creating involves creative thinking, and Industry planning involves problem solving skills. Bearing that in mind, we try to figure out teaching strategies which can effectively foster students' learning skills and teach them nano knowledge at the same time. To serve this purpose, we believe that Project-Based Learning (PBL) is worth trying and start to design a teaching plan. In PBL, students can attain the goal of the project by accomplishing a series of questions, problems and challenges [2]. At the same time, because of the widespread application of information and communication technology (ICT), ICT-assisted PBL is covered in many studies. Such teaching strategies prove to be effective in cultivating learning skills and imparting academic knowledge [3], [4].

Besides, we think that nanotechnology requires professional knowledge related to physics and chemistry, which made it harder for students who are not science major and have no basic knowledge in related fields. After taking other research suggestions into consideration, we will convert professional scientific knowledge to general knowledge that is extensively applied to other fields. Thus, such course will be easy for none-science-majors to comprehend [5]. In addition, in the course, experiments which can specifically demonstrate a scientific theory and phenomenon will be carried out to allow students to understand the cause and effect in scientific fields and further enhance their academic knowledge [6].

As mentioned above, in the general education courses, we will teach college students nano knowledge in ICT-assisted PBL to find out that, compared to traditional teaching strategies, the effectiveness and difference of ICT-assisted PBL has to general students, and to see whether nanotechnology in general education course is easier for business manage majors to understand.

II. The Study

This study adopted a pretest and posttest quasi-experimental design. The research design is shown in Fig. 1. The independent variable was ICT-assisted PBL, while the dependent variables were students' Nano knowledge (NK), Problem Solving Skill (PSS), Creative Thinking Skill (CTS), Concentration for Students in Classroom (CSL), and Motivated Strategies for Learning (MSL).

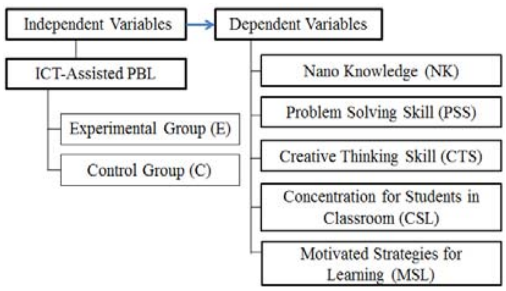

Fig. 1 Research design

Ya-Ting Carolyn Yang is with the Institute of Photonics, National Cheng Kung University, Tainan 701, Taiwan (phone: 06-2757575#56230; e-mail: yangyt@mail.ncku.edu.tw).
Ping-HanCheng is with the Institute of Education, National Cheng Kung University, Tainan 701, Taiwan (e-mail: astrocookie1031@gmail.com).
Shi-Hui Gilbert Chang and Chih-Chieh Li are with the Institute of Photonics, National Cheng Kung University, Tainan 701, Taiwan (e-mail:gilbert@mail.ncku.edu.tw , mia0101@gmail.com).
Terry Yuan-Fang Chen is with the Institute of Mechanical Engineering, National Cheng Kung University, Tainan 701, Taiwan (e-mail: ctyf@mail.ncku.edu.tw).

A. Participants

This study was conducted in general course in a university in Tainan. Fifty participants were randomly selected from the colleges of science, engineering, business, management and arts. Either class contained 25 students. One class served as a control group (C), receiving traditional instruction, and the other class as the experimental group (E) received ICT-assisted PBL instruction.

B. Research Procedures

Two classes met once per week for a 120-minute session of general course in nanotechnology. The duration of the experiment was 6 weeks. For both research groups, students completed five tests, including the test of NK designed by professor from college of science, PSS and CTS by the author, CSL and MSL as pretests at the beginning of the semester (week 1). Afterwards, they completed the same two tests and interviews as posttests during week 6. The interviews were conducted in groups between 5 and 10 minutes.

Both research groups were taught the basic level knowledge of nanotechnology. In control group (C), every week, the lecturer adopted traditional teaching strategy, using Powerpoint, teaching knowledge by chapters. In the experimental group (E), students had to finish the project of creating a product of nanotechnology. In the course, to get a handle of technique and application of nanotechnology, students accomplished the tasks and conducted experiments while developing the product. Also, the course in experimental group was integrated with ICT, such as the Internet, computer and tablets; therefore, students could gain more help online in a group discussion to accomplish tasks given by the lecturer. For example, students could watch videos, gather information, and keep the process in record through Moodle. In the end of searching, students would instantly share the results with the other groups and be given feedback. Outside the classroom, students could finish the assignment via online community and resources, continuing their learning. The class activities of the experimental group are shown in Table I.

C. Data Analyses

Both quantitative and qualitative data will be collected for this study (Table II). Cronbach'sα will be used as an estimate of the reliability of the evaluation. Descriptive statistics will be used to describe the means, standard deviations, and adjusted meansfor the tests between the two groups. Next, analysis of covariance (ANCOVA) will be used to compare the final results of the two research groups after 6 weeks of instruction, with pretest scores as covariates to eliminate the effect of any existing pretest differences on the results. From a qualitative perspective, data will be collected from feedback forms in the last week of lecture, through which we know students' acceptance of teaching strategies and improvement students thought we can make.

TABLE I
CLASS ACTIVITIES OF THE EXPERIMENTAL GROUP

	ICT-Assisted PBL
W1	Pretest
W2	1.Explaining the project of nanotechnology 2.Accomplishing the task of nanotechnology involving creative thinking skills
W3	1.Conducting nano experiment 2.Accomplishing the task of nanotechnology involving problem solving skills
W4	1.Conducting nano experiment 2.Accomplishing the task of nanotechnology involving problem solving skills
W5	1.Nano experiment 2. Accomplishing the task of nanotechnology involving creative thinking skills
W6	1.Presentation of the Project-Nano product 2.posttest

III. CONCLUSION

In the end of the research, five respective descriptive statistics from experimental group and control group will be received. With the statistics, contrasts between pretest and posttest as well as the between-group comparison can be made.

TABLE II
DATA TO BE COLLECTED

Questionnaires	Comparison Group		Experimental Group	
	Pretest	Posttest	Pretest	Posttest
NK	✓	✓	✓	✓
PSS	✓	✓	✓	✓
CTS	✓	✓	✓	✓
CSL	✓	✓	✓	✓
MSL	✓	✓	✓	✓

NK=Nano knowledge, PSS=Problem Solving Skill, CTS=Creative Thinking Skill, CSL=Concentration for Students in Classroom, MSL=Motivated Strategies for Learning.

Therefore, some assumption can be made according to these data.

1) First of all, given that both groups used the same teaching material, the contrast between pretest and posttest from both groups can tell the content validity of teaching material.
2) Secondly, because both groups adopted different teaching strategies, the contrast can be made by comparing the posttest results to see whether ICT-assisted PBL can help students know more about nanotechnology and achieve higher regarding concentration, motivation, problem-solving skills and creative thinking skills.
3) Thirdly, with the feedback gathered in the end of the course, researchers can try to find out the possible reasons that caused the differences between the two groups and further use it to improve the coursed in the future.
4) Lastly, if related researches could be continued and their results could be analyzed, we hope that it can be helpful for future teaching plan designers to apply nano knowledge to business management, making students active learners.

ACKNOWLEDGMENT

In this study, we could like to thank the administrators,

teachers, and students' participation from the experimental course.

REFERENCES

[1] I Malsch, "Nano-education from a European perspective," *Journal of Physics: Conference Series*, vol. 100, Part 3, 2008.
[2] P. C. Blumenfeld, E.Soloway, R. W. Marx, J. S. Krajcik, M. Guzdial & A.Palincsar. "Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning,"*Educational Psychologist*, vol. 26, Issue 3-4, pp. 369-398, 1991.
[3] D. Moursund, *Project-based learning using information technology (2nd)*, International Societyfor Technology in Education, 2003.
[4] L.-J,ChanLin,Technology integration applied toproject-based learning in science," *Innovations in Education and Teaching International*, vol. 45, Issue 1, pp. 55-65, 2008.
[5] L. Carter, "Globalisation and science education: Rethinking science education reforms," *Journal of research in science teaching*, vol. 42, no. 5, pp. 561–580, 2005.
[6] M. Scardamalia& C. Bereiter, *Knowledge Building: Theory, Pedagogy, and Technology*. Cambridge Handbook of the Learning Sciences. New York: Cambridge University Press. 2006, pp. 97-118.

Ya-Ting C. Yang received the Ph.D. degree in education from Purdue University, West Lafayette, IN,in 2002.She is currently an Associate Professor at the Institute of Education and Centre for Teacher Education, National Cheng Kung University, Tainan, Taiwan. Her research interests include the areas of educational research, development of higher order thinking skills,information and communications technology for improving teaching and learning processes, and biosignal technologies for innovative education.

Ping-Han Cheng is currently working at the Graduate Institute of Education, National Cheng Kung University, Tainan, Taiwan. His main research areas and expertise are project-based learning strategies, the digital curriculum development and science education. He obtained a master's degree at the Astronomy, National Center University.

Shih-Hui Gilbert Chang received the Ph.D. degree in Electrical and Computer Engineering from Northwestern University, Evanston, IL, in 2004 and the M.S. in Physics from University of California, Riverside in 1996. He was a postdoc researcher in Argonne National Lab, IL from 2004-2005. He is currently an Associate Professor in the department of Photonics, National Cheng Kung University, Tainan, Taiwan. His research interests include nanophotonics, plasmonics, and computational Electrodynamics.

Terry Yuan-Fang Chen received the Ph.D. degree in mechanical engineering from University of Florida, in 1985. He is currently a Professor at the Department of Mechanical Engineering, National Cheng Kung University, Tainan, Taiwan. His research interests include the areas of photomechanics, experimental stress analysis, opto-mechatronic measurement system development, and nondestructive testing.

Chih-chieh Li is currently working at the Graduate Institute of Education, National Cheng-kung University, Tainan, Taiwan. Her main research areas and expertise are project-based learning strategies, computer-supported collaborative learning and bilingual education. She obtained a bachelor's degree at English, National Kaohsiung Normal University.