Evaluation of Inquiry-based Learning with IRS in the Technique Course: A Pilot Study in Taiwan Industrial High School

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INTRODUCTION

Lai, Huang [1] described the current development of vocational high school in Taiwan. It's included six categories (Industrial, Business, Agricultural, artistic, maritime, and domestic) and divide into 80 departments. Industrial category was the common in the past few decades [2-4]. Most industrial high school students were learning a skill with high motivations and study theory course with lower motivations. And so on, enhancing learning motivation in the study theory course is become an important issue.

Inquiry-based learning is a way of interacting between teaching and learning which enhanced learning motivation [5]. Several learning approaches can be used to enhance the learning motivation and achievement [6-8]. Inquiry-based learning is one of learning approaches which grounded in the philoso- phy of John Dewey that begins with the curiosity of the learner[9]. Both Lin, Wen [10] and Shih [11] observed

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that inquiry based is growing up from an information relevance course. Chang and Lee [12] described that inquiry based learning approach is not universal in industrial high school.

Learning achievement is difficult to measure in inquiry-based learning [13]. The learning achievement is a complex progress in the inquiry based learning[14]. Demeulle, Lowther [15] described that assessment step by step can be ensured the learning achievement. Some computer technology can be supporting the assessment, like Interactive response system[16]. For the IRS implementation, the possible limitation is related equipment. Some application can be implemented under lessness requirement, e.g. Plickers[17]. Therefore, this study purposed to investigate learning motivation and achievement with/without Interactive Response System (IRS) integrated into the inquiry-based learning. The result had been analysis and provide evidence for inquiry-based learning.

1 LITERATURES REVIEW

1.1 Currently development of vocational high school

Educational technology is an effectively technology of vocational education in Taiwan [18]. When the updated hardware, dealing with security policy issues. Education has become an important issue. Today, educational technology to Taiwan construction-paper [19]. Most private school building, not only to bring them information about the device, but also set to improve teaching skills [20]. Most school construction have been tested for their innovative teaching methods, but there is little emphasis on the use of inquiry-based learning methods [21].

1.2 Inquiry-based learning

Graves, Juel, & Graves Graves, Juel [22] indicated that inquiry-based learning is an effectively instruction which evoke learners' deep thought. It's include five stage, Ask, Investigate, Create, Descuss, Reflect, shows in *Fig. 1*.

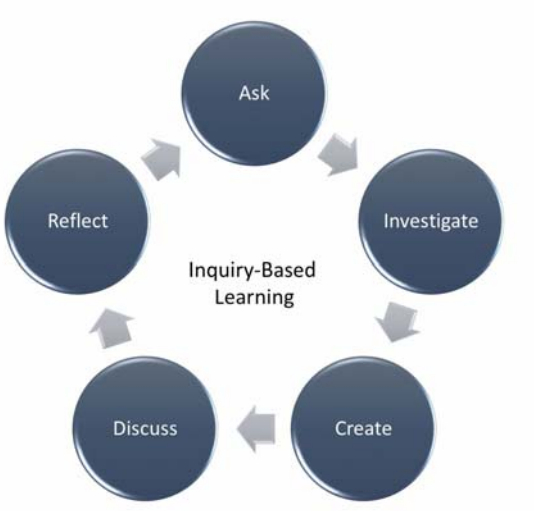

Fig. 1. The Inquiry Based Learning Process

Bruce [23] also applied the inquiry-based learning on the website and provide a platform for literacy development. The learning approach provide systemic learning loop for own student self-regulated learning. Hmelo-Silver, Duncan, & Chinn [14] proposed that inquiry-based learning can increase the critical thinking ability than traditional learning.

1.3 Learning motivation

Keller [24] developed the ARCS model based on theories related to psychology and motivation and by integrating systematic instructional design. On the basis of the ARCS theory, Keller [25] developed learning strategies that can be used in the four stages and explored factors necessitating consideration at various stages. At the attention and relevance stages, teachers should consider inspiring learning motivation by showing students that the materials are worth learning; at the confidence and satisfaction stages, teachers should focus on using various learning methods to motivate students and enable students to develop confidence and self-diagnosis abilities for future learning. Small and Gluck [26] also mentioned that the ARCS model can enhance systematic instructional design, ensuring that the design of learning materials can motivate learners to participate and interact in class. In addition, a theoretical framework and practical applications were proposed to affect learner participation, learner effort, and the duration of learner participation. The ARCS model can be used to assess the internal factors of students and the external factors in larning. In addition, cognitive and behavioral philosophies of learning were incorporated to create learning materials that can satisfy the motivational needs of students [27]. Keller and Suzuki [28] indicated that applying the strategies of the ARCS motivation model to course content can increase learner attendance and motivate students to adjust their learning attitudes.

1.4 Interactive Response System (IRS)

The Interactive Response System proposed by [29], who provide the teaching system for instruction. There are serval study implemented the IRS into educational experimentals. Fies [30] represented that the IRS can be immediately provide the response with software and add up the response distributed. In recently year, Plickers is a real time student assessment which using a free app and QR-code as tools to recived the learners response[31]. Mahoney [32] also proposed that Plickers include serval advantages, easy to use, low cost, and collect the feedback in real time. Its means the IRS tool, Plickers, which can be used in the information resources backward learning environment.

2 METHODS

2.1 Design and Sample

In the research design, inquiry-based learning approach in the learning activities was implemented with IRS, shown in *Fig. 2*. The application of IRS which applied in this study is Plickers . For evaluating the effectiveness, 35 participants ages 15-16 completed the learning activity used in this study. The topic of the learning activity was a mechanical drawing practice course in vocational high school.

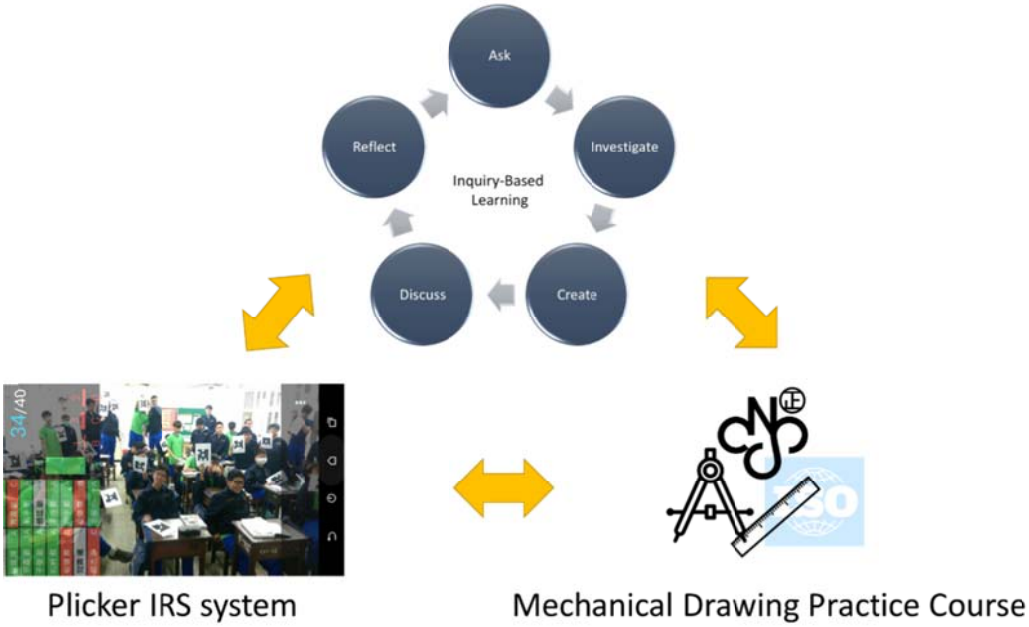

Fig. 2. The Research design of this sutdy

2.2 Data collection and Procedrues

The learning activity progress took a total of 8 weeks, including two stages as shown in *Fig. 3.*

Fig. 3. The Procedrues of this sutdy

First stage, normal inquiry-based learning was used in the instruction for 4 weeks. In the second stage, the inquiry-based learning with IRS took after the first stage. Each stage took 20 tasks for learning activity. The aim of this study was to determine the effectiveness of an inquiry-based learning approach with regard to improving vocational high school students' learning motivation and achievement. When learners finished the learning activity, the ARCS motivation questionnaires and the exam for conceptual knowledge were taken. The paired t-test analysis of learning motivation and achievement, which evaluating the effectiveness between pre-test and post-test.

3 RESULTS

3.1 Learning achievement

An paired sample t-test was conducted both different variable and pre-/post- test, and the results in Table 1 indicate that using IRS to engage in inquiry based learning lead to better learning achievement than without IRS ($p<.05$). This shows that the IRS system in the inquiry based learning also helped the students, by letting them keeping them engaged in the task.

Table 1. Paired t-test of the learning achievement for with/without IRS

Variable	Pre-test		Post-test		t
	Mean	SD	Mean	SD	
With IRS	15.28	8.21	74.57	6.79	29.497***
Without IRS	15.31	7.90	84.85	7.21	38.716***

3.2 Learning motivation

An paired sample t-test was conducted, and the results in Table 2 indicate that using IRS to engage in inquiry based learning lead to better learning motivation than without IRS ($p<.05$). This shows that the distribution of tasks in the inquiry based learning also helped the students, by letting them receive more interest from the IRS system.

Table 2. Result of ARCS motivation questionnaire scale

Variable	Mean	SD	t
With IRS	89.47	5.31	3.78***
Without IRS	73.21	8.54	

4 CONCLUSIONS

The result indicated that learning motivation and achievement can be increased with the IRS. Furthermore, the result of learning motivation point out that IRS supporting inquiry based learning is higher than without IRS. Otherwise, learning achievement is significantly different between inquiry-based learning with and without IRS. The mean of with the IRS is higher than without IRS. Above all, an inquiry-based learning approach is implemented with interactive response system (IRS) in vocational high school. Overall, learning motivation can be increased through the IRS supporting inquiry based learning activity. It would promote learners' learning desire and learning effectiveness. Most learners hopefully can be performed inquiry-based learning with IRS in their future learning activities.

REFERENCES

[1] Lai, C.-H., et al. . in *Interactive Collaborative Learning (ICL), 2015 International Conference on*. 2015. IEEE.

[2] Lin, T.-C., *The role of higher education in economic development: an empirical study of Taiwan case.* Journal of Asian Economics, 2004. **15**(2): p. 355-371.

[3] Chiang, Y.-C., et al., *A Study on Investigating Learning Styles and Skills Learning Motivations for Mechanical Department Students in Vocational High Schools.* International Journal of Information and Education Technology, 2016. **6**(11): p. 851.

[4] Lin, K.-Y., et al., *Examining the gaps between teaching and learning in the technology curriculum within Taiwan's 9-year articulated curriculum reform from the perspective of curriculum implementation.* International Journal of Technology and Design Education, 2015. **25**(3): p. 363-385.

[5] Owens, R.F., J.L. Hester, and W.H. Teale, *Where do you want to go today? Inquiry-based learning and technology integration.* The Reading Teacher, 2002. **55**(7): p. 616-625.

[6] Elliott, E.S. and C.S. Dweck, *Goals: an approach to motivation and achievement.* Journal of personality and social psychology, 1988. **54**(1): p. 5.

[7] Huang, Y.-M., S.-H. Huang, and T.-T. Wu, *Embedding diagnostic mechanisms in a digital game for learning mathematics.* Educational Technology Research and Development, 2014. **62**(2): p. 187-207.

[8] Huang, Y.-M., et al., *A Jigsaw-based Cooperative Learning Approach to Improve Learning Outcomes for Mobile Situated Learning.* Educational Technology & Society, 2014. **17**(1): p. 128-140.

[9] Dewey, J., *Reconstruction in philosophy*. 1957: Beacon Press.

[10] Lin, Y.-T., et al., *A cloud-based learning environment for developing student reflection abilities.* Computers in Human Behavior, 2014. **32**: p. 244-252.

[11] Shih, H.-C. *The Effectiveness of Technology-Mediation on Learning Second Foreign Language-A Case Study of Vocational College Students*. in *The International Conference on E-Technologies and Business on the Web*

(EBW2013). 2013. The Society of Digital Information and Wireless Communication.

[12] Chang, L.-C. and G.C. Lee, *A team-teaching model for practicing project-based learning in high school: Collaboration between computer and subject teachers.* Computers & Education, 2010. **55**(3): p. 961-969.

[13] Geier, R., et al., *Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform.* Journal of Research in Science Teaching, 2008. **45**(8): p. 922-939.

[14] Hmelo-Silver, C.E., R.G. Duncan, and C.A. Chinn, *Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006).* Educational Psychologist, 2007. **42**(2): p. 99-107.

[15] Demeulle, L., D.L. Lowther, and G.R. Morrison, *Integrating computer technology into the classroom*. 1998: Prentice Hall PTR.

[16] Stewart, D.W., et al., *Active-learning processes used in US pharmacy education.* Am J Pharm Educ, 2011. **75**(4): p. 68.

[17] Bergeron, L.E., et al., *Method and apparatus for the generation of reports*. 1991, Google Patents.

[18] Bates, A.T., *Technology, e-learning and distance education*. 2005: Routledge.

[19] Chou, C., *Incidences and correlates of Internet anxiety among high school teachers in Taiwan.* Computers in Human Behavior, 2003. **19**(6): p. 731-749.

[20] Dolence, M.G. and D.M. Norris, *Transforming higher education: A vision for learning in the 21st century*. 1995: Society for College and University Planning Ann Arbor, MI.

[21] Hwang, G.-J., C.-C. Tsai, and S.J. Yang, *Criteria, Strategies and Research Issues of Context-Aware Ubiquitous Learning.* Educational Technology & Society, 2008. **11**(2): p. 81-91.

[22] Graves, M.F., C. Juel, and B.B. Graves, *Teaching Reading in the 21st Century*. 1998: ERIC.

[23] Bruce, B.C. and A.P. Bishop, *Using the Web to support inquiry-based literacy development.* Journal of Adolescent & Adult Literacy, 2002. **45**(8): p. 706.

[24] Keller, J.M., *Motivational Design of Instruction. Instructional Design Theories and Models: An Overview of their Current Status. Ed. CM Reigelruth*. 1983, Hillsdale, NJ: Lawrence Erlbaum.

[25] Keller, J.M., *Development and use of the ARCS model of instructional design.* Journal of instructional development, 1987. **10**(3): p. 2-10.

[26] Small, R.V. and M. Gluck, *The Relationship of Motivational Conditions to Effective Instructional Attributes: A Magnitude Scaling Approach.* Educational technology, 1994. **34**(8): p. 33-40.

[27] Small, R., *Motivation in instructional design.* TEACHER LIBRARIAN-SEATTLE-, 2000. **27**: p. 29-29.

[28] Keller, J. and K. Suzuki, *Learner motivation and e-learning design: A multinationally validated process.* Journal of Educational Media, 2004. **29**(3): p. 229-239.

[29] Lahlou, B., *Student teaching system and the like and related method*. 1974, Google Patents.

[30] Fies, C. and J. Marshall, *Classroom response systems: A review of the literature.* Journal of Science Education and Technology, 2006. **15**(1): p. 101-109.

[31] Mays, S. and J. Mueller, *Plickers! Real Time Student Assessment Using a Free App for Classroom and Individual Assessment in Your Hand--No Other Equipment Needed.* 2015.

[32] Mahoney, J., *Using Technology to Accommodate, Differentiate, and Grade SWD for Academic Success.* 2015.