



Research Paper

Impact of in-service adult learners' self-directed learning and learning effectiveness on performance of project management competence: A case study of students with learning experience in project management courses

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ABSTRACT

This study focuses on in-service adult learners with experience in project management in adult education institutions as subjects. Data is collected through questionnaire survey for statistical analysis, confirmatory factor analysis and reliability analysis. In addition, this study constructs questionnaires regarding self-directed learning (SDL), learning effectiveness evaluation and performance of project management competence through empirical study and explores the impact of adult learners' self-directed learning and learning effectiveness on the performance of project management competence. This study finds that adult learners' self-directed learning and learning effectiveness are moderately or highly correlated with the performance of project management competence and significantly improves the performance of project management competence. Therefore, this study recommends that the self-directed learning of in-service adult learners with learning experience in project management courses should be assisted and their learning effectiveness promoted in order to enhance the performance of project management competence, encourage their sustainable development career and achieve project management goals.

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INTRODUCTION

Research motives

Due to the ever-changing times, lifelong learning has become one of the best activities to adapt to changing environments and in-service adults in particular are confronted with innovation, the development of technology and updated management methods. If they do not immerse themselves in improving their professional competence, they will have difficulties in responding to changing modern workplace environments and may be replaced at any time: "as in the Yangtze River where the waves behind drive on those before, so a new generation always excels the last one." Regardless of receiving complete formal education, when faced with the

challenges posed by new tasks, adults will actively search for ways and methods that can improve their work effectiveness and demonstrate their value and competence in order to avoid being replaced. The learning methods that in-service adults can freely choose encompass all learning activities which can help improve professional competence, including the pursuit of a degree through continuing formal education at university, informal short-term competence training, as provided by their companies or other organizations, and even informal and diversified self-development. In other words, learning activities attended by in-service adults are featured by obvious

objectives, demands, functions, effectiveness and self-direction. Moreover, the autonomy of adults when choosing further study is greater and their performance of self-directed learning is more obvious than that of the young people taught by formal educational institutions.

According to Peters and Waterman (2005), "more than 90% of white-collar workers face a crisis in the future. That is, all future white-collar work will be project work, as well as work of economic value." Overall, project work has gradually become the major work task in the current workplace and project management is the main project management. Moreover, project management is regarded as international professional certification, for example, the International Project Management Association (IPMA) of the European Union and the U.S. Project Management Institute (PMI) proposed the project management competence baseline and project management knowledge system. In addition, they conducted certification of project management competence in accordance with the architecture, processes, methods, competence baseline and other connotations of a project management knowledge system, as prepared by them and in various test methods and those who pass certification are known as Project Management Professionals (PMP). Furthermore, the professional levels of PMP are subject to professional competence classification and certification based on the complexity and scale of the management project. For instance, according to IPMA, PMPs are categorized into Certified Projects Director (IPMA Level A), Certified Senior Project Manager (IPMA Level B), Certified Project Manager (IPMA Level C), and Certified Project Management Associate (IPMA Level D). The aforesaid PMP certificates are listed as important and crucial management competence certifications by a wide range of industries in developed countries. Therefore, the performance of project management competence has become one of the necessary professional competences in contemporary professional workplaces.

In a book titled *The Inquiring Mind*, Cyril (1961) described adult learning as a kind of highly independent and planned study. Through empirical study, Tough (1989) not only proved that "highly conscious learning" was the essence of adult activities, he also confirmed that each adult spent an average of five hundred hours attending about five different learning programs each year. Later, scholars began to study the characteristics of adult learning and why adults preferred self-planned learning. How can we determine whether adults' self-directed learning achieves the learning effectiveness of the purposes, demands and functions and how can learning effectiveness be determined? A host of scholars developed evaluation models to assist in the evaluation of training effectiveness; among them, the four Levels evaluation model, which focuses on reaction, learning, behavior and result as proposed by Kirkpatrick (1959) is most common. This study intends to learn about the current overall

performance of SDL, the learning effectiveness of in-service adult learners with learning experience in project management courses and the impact on the performance of project management competence, which is the main motive of this study.

Research purposes

On the basis of the aforementioned research motives, the purposes of this study are presented, as follows:

- (1) To understand the connotation of adults' self-directed learning, learning effectiveness and performance of project management competence;
- (2) To prepare questionnaires regarding adults' self-directed learning, learning effectiveness and performance of project management competence;
- (3) Explore the impact of adults' self-directed learning and learning effectiveness on the performance of project management competence;
- (4) Put forward conclusions and suggestions based on the research findings and strengthen the effectiveness of adults' self-directed learning in order to enhance their performance of project management competence.

Research method and process

This study first probes into and analyzes the connotations of adults' self-directed learning, learning effectiveness and performance of project management competence in order to prepare the "Draft Questionnaire regarding Adults' Self-directed Learning, Learning Effectiveness and Performance of Project Management Competence," and takes in-service adult students with training experience in project management courses from adult education institutions (including the Open University of Kaohsiung, Kaohsiung Tribal College, Labor College Kaohsiung and College of Continuing and Extension Education) as the subjects. A pre-test questionnaire was conducted in order to establish the reliability and effectiveness of the questionnaire before the formal questionnaire was drawn up for the formal questionnaire survey. When the questionnaire survey was complete, the questionnaires were collected for statistical analysis where descriptive statistics, inferential statistics and other methods were employed to learn about the tested samples, the in-service adult learners of different social backgrounds and their perceptions and differences in self-directed learning, learning effectiveness and performance of project management competence. In this way, this study intends to understand, analyze and explore the relationship of subjects' self-directed learning, learning effectiveness and performance of project management competence. Finally, this study arrives at the conclusions and offers feasible

strategies to enhance the SDL effectiveness of in-service adult learners, as well as, the performance of project management competence.

Research structure

Figure 1 shows the statistical and analytical structure of this study. This study probes into in-service adult learners with learning experience in project management courses, and regards their gender, age, educational background, occupation, position, organizational history and organizational scale as the social variables of this study. The dependent variables are adults' self-directed learning, such as readiness to learn, active learning and creative learning, as well as, learning effectiveness, such as satisfaction with service, knowledge improvement, knowledge application and competence performance. Finally, the dependent variables include project initiation, project planning, project monitoring and control, project closure and other performances of project management competence. The relationship between the variables is explored through empirical research and inferential statistical analysis.

Statistical analysis

- (1) The differences in the perceptions of self-directed learning, learning effectiveness, and performance of project management competence of in-service adult learners with different social backgrounds are determined through t-testing and one-way ANOVA analysis;
- (2) The correlation and degree of cognition of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners with different social backgrounds are analyzed with Pearson's product-moment correlation coefficients.
- (3) The predictive power of the cognition of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners are determined through regression analysis.

MEANING AND RESEARCH OF SELF-DIRECTED LEARNING

Meaning of self-directed learning

Self-directed learning was first proposed by Tough (1966) and was described as a process where individuals, with or without the help of others, can diagnose their learning needs, set up learning goals, identify learning resources, choose and implement appropriate learning strategies and evaluate learning outcomes. It was designed to promote self-planning and managerial learning in order to achieve

personal, social and professional development (Chung and Chang, 2007; Workforce Development Agency, Ministry of Labor, 2016a). Learning outcomes can be improved through the curriculum training of self-directed learning and self-directed learning has become a new trend of modern formal and non-formal education. Knowles (1975) classified the self-directed learning model into six steps: scenario construction, diagnosing learning needs, setting up learning objectives, identifying learning resources, choosing and implementing learning strategies and evaluating learning outcomes in order to benefit the evaluation of learners' learning course.

The operation of adult learning was in essence, self-directed learning, where the adult was responsible for their own learning and was expected to produce the best learning outcomes (Knowles, 1975). Self-directed learners were characterized by active learning, readiness to learn, not afraid of difficulties and appropriate use of resources to attain their learning goals (Guglielmino, 1977). Knowles (1975) maintained that self-directed learning had the following five basic assumptions: 1) As a person matures, his/her self-concept moves from one of being a dependent personality toward one of being a self-directed human being; 2) As a person matures he/she accumulates a growing reservoir of experience that becomes an increasing resource for learning; 3) As a person matures, his/her readiness to learn becomes increasingly oriented to the developmental tasks of his/her social roles; 4) As a person matures, his/her time perspective changes from one of the postponed application of knowledge to immediacy of application and accordingly, his/her orientation toward learning shifts from one subject-centeredness to one of problem-centeredness; 5) As a person matures, the motivation to learn is internal, such as the need for respect and achievement. Tough (1979) suggested that the planning abilities of self-directed learners should include: 1) Selecting and presenting appropriate preparation steps; 2) Diagnosing what assistance is necessary; 3) Selecting and using useful resources and 4) Analyzing the entire learning plan.

From the perspective of the learning process, Knowles (1975) pointed out the process of SDL; "in which individuals take the initiative, with or without the help of others in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies and evaluating those learning outcomes." From the perspective of personality traits, Fellen (1985) and Oddi (1986) pointed out that self-directed learning referred to a series of activities in the course of self-education, including learners' intrinsic orientation, internal control, autonomy and other motivations, cognitions, emotions, traits and personality. According to Kratz (1980), Brookfield (1985) and Guglielmino (1977) from the viewpoint of competence, self-directed learning meant that learners had the ability

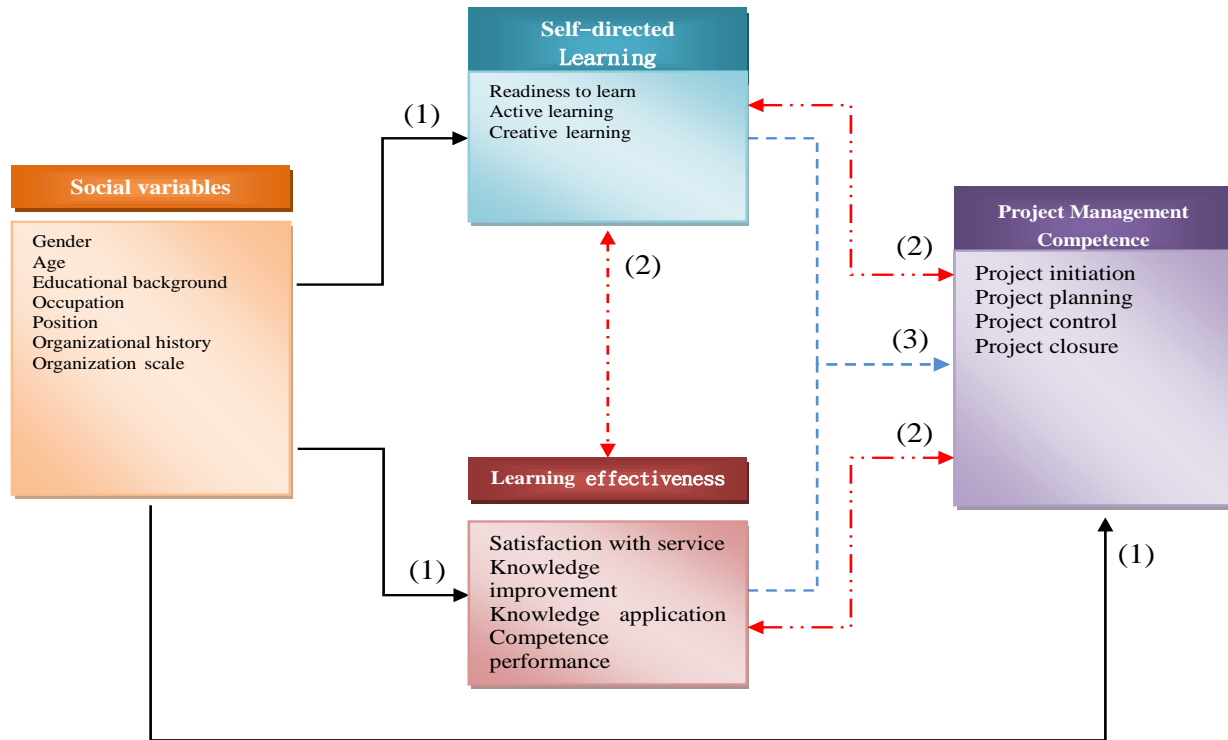


Figure 1: Research framework. Source: Prepared by the researchers.

to plan their learning goals, select contents and methods of learning, stimulate learning motivation and carry out learning activities in an independent and continuously innovative manner.

This study defines self-directed learning by summarizing the opinions of Guglielmino (1977), Driscoll (1994), Tough (1966), Gendron (2006), Lehmann and Fryd (2008), Deng (1995), Ting (1996), Ho (1997), Deng (2000), Chen et al. (2001), Huang (2002), Chi (2002), Eble (1998), Roberson and Merriam (2005), Donavant (2009), Huang (2004), Chang (2004), Hsu (2009), Ting (2007), Wu (2008), Chen and Liang (2009), and Tsai and Wu (2010). Specifically, this study gives the following definitions of in-service adult learners' self-directed learning: In order to attain their learning objectives, in-service adult learners, with the learning motivation of wholeheartedly and actively throwing themselves into innovative research and development will develop the learning attitude and methods of readiness to learn, achieve active and innovative learning, carry out self-initiation, planning, participation and examination, and improve their various learning activities.

Relevant research into self-directed learning

Since Tough (1966) and Knowles (1975) advocated the concept of self-directed learning, a host of adult educators

have conducted a vast range of research into the impact and relationship of various outcome variables based on different research topics, samples of varied social variables and research areas and by taking self-directed learning as the control variable. They summarized their research findings, and then, put forward a myriad of theories regarding self-directed learning as follows: Tough (1979) explained the connotation of self-directed learners' self-planning ability. Knowles (1979) valued the interactions between learners and facilitators and emphasized the contents, goals and ways of learning. Long (1987) stressed that the learners' learning environment, learning process and learning outcomes were crucial factors to encourage self-directed learning. Brockett and Hemstra (1991) proposed that good self-directed learning should be based on a combination of "learners' responsibilities" and "learners' needs or preferences." Grow (1991) believed that the facilitators of learning play different roles in different stages, divided learners' learning status into four stages and used the learners' traits in different stages to enhance their self-directed capacity (Chen and Liang, 2009).

This study collects different research topics and dimensions, as proposed by different researchers from various fields of self-directed learning in order to verify their conformance with the theory and use them as references for this study. Table 1 shows the related research topics and dimensions.

Table 1: Summary of related research in research topics and dimensions of self-directed learning.

Researcher	Time	Topic	Dimension
Guglielmino	1977	Development of the self-directed learning readiness scale	Openness and self-concept, active and independent learning, self-responsibility, love of learning, creativity, future orientation, learning skills, and problem solving.
Deng	1995	An Experimental Study on the Effects of Self-directed Learning on Adult Students' Learning Behavior and Academic Achievement	Efficient learning, love of learning, learning motivation, active learning, independent learning, and creative learning.
Kao	2002	The Influence of Employees' Self-directed Readiness on Organizational Learning Effectiveness -- A Case Study of the Life Insurance Service Industry	Create learning, continuous learning, self-understanding, love of learning, and learning initiative.
Chi	2002	The Relation between Self-directed Learning Readiness and Knowledge Sharing Willingness for Business Employees	Love of learning, efficient learning, learning motivation, active learning, independent learning, and creative learning.
Yu	2003	A Study on the Relationships among Employee Personality, Self-Directed Learning, and Work Performance	Efficient learning, love of learning, learning motivation, active learning, independent learning, and creative learning.
Chang	2004	The Influences of Self-directed Readiness and Learning Satisfaction to the Intention of Continuing Study -- The Examples of Open Universities in the Kaohsiung Area	Love of learning, efficient learning, active learning, independent learning, creative learning, and learning motivation
Huang	2004	Research of the Relationship among Self-directed Learning Readiness, Classroom Climate, and Learning Satisfaction of Adult Learners	Self-understanding, love of learning, active learning, and continuous learning.
Su	2006	A Study on the Relationship of Self-directed Learning Readiness and the Degree of Learning Satisfaction for the Full-time Administrative Staffs in Junior High Schools in Kaohsiung City and County.	Self-understanding, continuous learning, learning motivation, active learning, and love of learning.
Ting	2007	The Relationships among Self-directed Learning, Internet-usage, and Learning Achievement in the University of Science and Technology--Taking the National Formosa University as an Example	Active learning, efficient learning, innovative learning, love of learning, independent learning, and learning motivation.
Chen and Liang	2009	A Study of Recurrent Education Students' Perception and Measurement Instrument upon Self-directed Learning in Higher Education -- A Case Study of Students in One Continuous School of a Private Technical University	Love of learning, active learning, independent learning, and creative learning.

Source: Compiled by this study.

In accordance with the aforementioned researchers' research into the topics and dimensions of self-directed learning, SDL mainly includes enthusiasm for and love of learning, active and independent learning, creative learning, continuous learning, self-concept, responsibility for learning and learning motivation, etc. This study based on the research topics, objectives and sample characteristics summarizes three dimensions of self-directed learning including readiness to learn, active learning and creative learning and regards them as reference for the development of a self-directed learning scale and tool in this study.

MEANING AND STUDY OF ADULTS' LEARNING EFFECTIVENESS

Meaning of learning effectiveness

Learning effectiveness is also known as learning outcome. This study focuses on the learning effectiveness of in-service adult learners. Therefore, the learning effectiveness mentioned in this study means that, in-service adult learners attend a vast range of courses and learning activities offered by adult education institutions in order to attain the desired learning objectives. The

learning effectiveness of in-service adult learners, in addition to improving their general life knowledge, skills and developing good habits is most important to hone the professional competences required by the workplace, which is the predominant objective. The demonstration of learning effectiveness must be evaluated by learning process and results to determine the demonstration degree of learning effectiveness. The effectiveness evaluation of in-service adult learners' attending courses can first be judged according to their satisfaction with various learning items, including the adult education institutions' teachers, teaching materials, courses, equipment and administrative services. Secondly, it is improvement in acquired knowledge, skills, values, attitudes and feelings; thirdly, learners' improvement in competence performance should be tracked on a continuous basis after class; finally, it should be understood whether the competence improvement, as resulted from study serve the practical purposes of improving the overall performance of individuals, departments and organizations.

Goldstein (1993) indicated that the assessment of training effectiveness referred to the collection of information regarding training activities in a systematic manner as the basis for selection, adoption, evaluation and correction of training activities. Jedrzejewski (1995) described assessment of training effectiveness in more detail: 1) Evaluate training effectiveness to determine whether the objectives of training programs are achieved; 2) The process of implementing training programs and the final effectiveness are the focuses of evaluation; 3) Judge whether the training programs attain the established objectives; 4) Evaluate the advantages and disadvantages of training programs; 5) Evaluate who benefits the most and the least from training; 6) Evaluate whether the training programs enhance both the trainees' individual's work performance and the overall performance of the organizations; 7) Evaluate whether the training programs achieve the established purposes or objectives; 8) Judge whether the training programs have value. If evaluation is conducted according to the different stages of the training activities, it can be divided into in-training evaluation and post-training evaluation. The former is also known as process evaluation or formative evaluation, for example, "whether the training programs meet the demands," "whether the training hours and times are appropriate," "what are the trainees' responses," and "whether the trainees obtain some specific knowledge." By contrast, the latter is also referred to as conclusive evaluation; for example, "whether the trainees obtain all knowledge," "how much knowledge can be applied to work," "whether the trainees' behavioral changes meet the training objectives," and "the cost-effectiveness of training outcomes" (Li, 2010; Wang, 2004).

The evaluation models or scales for learning effectiveness garnered in this study encompass the CIPP

model of Stinklebeam (1983), model of Kirkpatrick (1959), model of Goldstein (1966), model of Brinkerhoff (1988), IPOO model of Bushnell (1990), model of Fitzpatrick (1996) and model of Parry (1997) as well as, the EOQ scale of Hadley (1975), PALS scale of Conti (1979), EDQ scale of Kerwin (1980), API scale of Suanmali (1981), SOQ scale of Christian (1982), scale of Davidson (1997), scale of McEwan (2000), and scale of Elliott (2000). However, this study uses the references of the 5 major processes (for example, Plan, Design, Do, Review and Outcome) and 19 assessment indicators for talent development quality management of corporate institutions and training institutions, as set out in the Talent Quality Management System (TTQS) promoted by the Workforce Development Agency. In addition, this study refers to the "17a reaction," "17b learning," "17c behavior," and "17d outcome" in the 17 assessment indicators as the structure and items of the assessment scale for learning effectiveness, as prepared by this study (Hsieh, 2012; Kao, 2014, 2016; Lin and Chiu, 2010; Wang, 2011; Workforce Development Agency, Ministry of Labor, 2016b).

The outcome indicators of the TTQS are developed by referring to the evaluation model for learning effectiveness by Kirkpatrick (1959, 1960, 1994), which divided the evaluation of training effectiveness into four levels as: 1) Reaction levels: This means that investigation and analysis of satisfaction and feedback of trainees/instructors are summarized and analyzed as the basis for improving the next curriculum planning and courses are improved with specific effects based on the improvement decisions; 2) Learning levels: Examinations, practical reports, or other specific learning activities are conducted, the results and insufficiencies are summarized, analyzed and included in the final report as the basis for improving curriculum planning and courses are improved according to specific effects based on the improvement decisions; 3) Behavior levels: Learners are offered assistance to implement after-class action plan evaluations, which requires a mechanism; related records that can demonstrate the records of handling or tracking customers' implementation and relevant records that can display specific effectiveness; 4) Results levels: Learners are offered assistance to evaluate whether the training effectively satisfied the needs of their organization or work, as well as, a mechanism and related records, which can demonstrate the records of handling or tracking customers' implementation and relevant records that can display specific effectiveness (Kao, 2014, 2016; Li, 2010; Liu, 2007; Workforce Development Agency, Ministry of Labor, 2016b). Kirkpatrick (1994) also put forward three reasons for the importance of training effectiveness: 1) Training effectiveness can substantiate the contribution of training outcomes for the attainment of organizational goals and provide reasons for the continued existence of training departments; 2) Training effectiveness can be used as a basis for determining whether the training activities should be continued; 3) The evaluation of

training effectiveness can provide information regarding how to improve future training activities.

Related research into of adults' learning effectiveness

Literature on the learning effectiveness of adults' in-service training indicates that the trainees' personalities are of great importance to the effects of training, as well as, the outcomes of follow-up trainings (Mathieu et al., 1992; Noe, 1986; Noe and Ford, 1992; Salas and Cannon-Bowers, 2001). Huang (2006) and Seetoo (2011) maintained that organizational operational patterns would exert effect on the learning effectiveness of adults' in-service training. Wang (2004, 2006, 2013), Yu et al. (2007), Sun and Li (2007), Ho (2008), Ko (2008), Li (2010), Weng (2011), Chien (2012), Chiang (2013), Fleishman (1953), Baumgartel and Jeanpierre (1972), Steiner and Kelly (1976), Brainard and Ommen (1977), Grubbs (1981), Tubiana and Ben-Shakhar (1982), Dale et al. (2005), Kushnir et al. (2008), Centeno and Corrêa (2008), Kao (2014) and Kao et al. (2016) used the four-level model by Kirkpatrick to construct models for learning effectiveness, or regarded it as a dimension of empirical research in order to probe into the various social variables (such as gender, age, education level, organizational scale, organizational history, occupational category and positions, etc) as well as, the varied control variables of education and training in order to explore the relationship with and impact on learning effectiveness.

By summarizing the aforementioned research and literature regarding the learning effectiveness of adults' in-service training, this study defines the dimensions of learning effectiveness as satisfaction with service, knowledge improvement, knowledge application and competence performance as reference for preparing the scales and tools of self-directed learning in this study.

MEANING AND RESEARCH OF PROJECT MANAGEMENT COMPETENCE

Meaning of project management competence

By summarizing the definitions of project management as presented by international professional organizations (IPMA, 2009; PMI, 2012) and project management scholars (Kao, 2013b, 2014; Kerzner, 2006; Lewis, 2002, 2008; Lu and Kao, 2013), this study believes that project management refers to a management art, where limited resources and conditions are driven by established and unique visions and targets and people use the most effective and systematic management flows to integrate human resources and other resources to fulfill tasks.

The operation system of project management includes the establishment of project management goals, planning

of operational processes, operational processes, building of teams, allocation and use of resources, platform for information and knowledge management and establishment of policies. In this way, resources and labor are integrated for project business in order to complete tasks and attain the goals of the project. Regarding the connotations of project management processes, many scholars and professional teams in the domain of project management have had unique theoretical and practical insights, such as Ting (2004); Editorial Board of Taiwan's Project Management Association (2014); Lu (2009); Lin et al. (2005); Lin (2015); Kao (2011a, 2011b, 2013b); Chi (2005); Hsu (2004); Kuan (2016); Cleland and Ireland (2005); Cooke and Tate (2005); Cooke (2005); Hearnkens (2002); IPMA (2009); Kerzner (2006); Lewis (2002); PMI (2012); Tobis and Tobis (2003). This study intends to integrate the aforementioned discussions and proposes that the connotation of project management processes include project initiation, planning, monitoring, control, and closure.

Competency was derived from McClelland (1973), who replaced competence measurement with intelligence and used it as a predictor of personal success. The connotation of competence encompasses knowledge, skills and feelings and is measured according to external behaviors. Additionally, competence can be subdivided into the abilities "acquired" by individuals, meaning the acquisition of knowledge, skills, feelings and "demonstrated" abilities, namely, the successful completion of a certain task from actual behavioral performance (Kang, 1997; Wu, 2014).

Cheng et al. (2009) defined competence as "an ability to use knowledge, attitude, and skills to perform a task and all behaviors, motives and knowledge regarding the success or failure of work (Wu, 2013). Spencer and Spencer (1993) proposed the iceberg model and suggested that competences included five major elements, skills, knowledge, self-concept, traits and motives. Skills and knowledge were more explicit and easily trained, developed and changed much like an iceberg on the surface of water and were superficial competences. On the contrary, self-concept, traits and motives were relatively implicit and difficult to change much like the part of an iceberg hidden under the surface and were implicit competences. The project management competences, as investigated in this study, refer to the explicit competences for project management, as acquired by the project managers.

In light of the ICB 3.0, as issued by IPMA (2009), the competence baseline includes technical competences (20 elements), behavioral competences (15 elements) and contextual competences (11 elements) for a total of 46 project management elements. Moreover, this benchmark is regarded as the reference standard for promoting project management education, training and certifying project management competence by IPMA member states and organizations worldwide. PMI (2012) points out that

project managers achieve tasks through the project team and other stakeholders and that efficient project managers must strike a balance between ethics, interpersonal interactions and conceptual skills in order to self-analyze situations and appropriately interact with others. The interaction skills with the stakeholders include leadership, team building, motivation, communication, influencing, decision making, politics, culture and cultural awareness, negotiation, trust building, conflict management and coaching.

Based on the aforementioned literature, this study takes the operational processes of project management initiation, planning, monitoring, control and closure as the framework of project management competence. To be more specific, project initiation includes five items, initiating effective projects, setting project goals, preparing a project concept book (draft), operating tools and technology for the project's feasibility analysis and preparation of the project letter of authorization. Project planning competences include ten items, preparation of project proposal, operation project schedule, budget, quality, scope, risk, human resources, equipment and supplies, procurement bidding, communication with stakeholders and other planning tools and technologies.

Project monitoring and control competences include ten items, progress of monitoring and control of projects, budget, quality, scope, risk, human resources, equipment and supplies, procurement bidding, stakeholders, related laws and contracts. Project closure competences include five items, operation project closure, contract termination, closure of administrative affairs, convening of project review meetings, knowledge and experience documents of management projects and other operational tools and technologies.

Research into project management competence

Research and exploration into project management competence encompass the ICB 3.0 project management competence baseline issued by IPMA (2009), management competence project of project managers formulated by PMI (2012) and the "Taiwan National Competency Baseline" (TNCB) prepared by the Editorial Board of Taiwan Project Management Association and other related constructs and promotions of project management competence baselines. Furthermore, competence baselines are regarded as the qualification certification standards for Project Management Professional (PMP). Additionally, Kao and Chen (2009) constructed a project management maturity model and its auditing project. Kao (2011a) compiled a practical operation index of project management for national primary schools. Cheng (2013) constructed the project management competence indices for management personnel in the research and development of high-technology industries. Kao (2013a)

integrated the knowledge system and management processes of ISO, PMI and UK PRINCE2, proposed organizational roles and tasks, management structure and management processes for project management and constructed the "project management indices" in accordance with the project management competence baseline as developed by IPMA. Kao (2014) constructed a project management index for creating residential communities according to the topic of project management.

Regarding the exploration of the variables of project management competence, by summarizing the research variables of Tsai (2001), Kao and Chen (2009), Kao (2011a, 2013a, 2014, 2015), Shen (2012), Cheng (2013), Chang (2014), Wu (2014) and Lin (2015), the aforementioned studies regarded gender, age, education level, organizational scale, organizational history, occupational category and positions as the main social variables, took the project management processes and execution projects as the operation variables and organizational effectiveness as an outcome variable. By summarizing the aforementioned research and literature regarding project management competence, this study determines the dimensions of management competence as project initiation, project planning, project monitoring and control and project closure as reference for preparing the scales and tools of self-directed learning.

Construction of questionnaire scale

Due to the lack of relevant questionnaires on adults' self-directed learning, learning effectiveness and project management competence, this study intends to construct and compile an appropriate and effective questionnaire scale able to reflect the purposes of this study through collecting, sorting and classifying related theories, research and literature. This study takes in-service adult learners with experience in attending project management courses at adult education institutions in 2015 as the subjects and prepares the sub-scales of the questionnaire of this study. During the course, related literature is sorted and analyzed and the questions in the questionnaire, which consist of an overview of adults' self-directed learning, learning effectiveness, and performance of project management competence are edited. Then, expert validity is conducted and statistical and analytical methods such as construct validity and reliability employed to prepare the questionnaire of this study.

Methods to prepare questionnaire include an overview of adults' self-directed learning, learning effectiveness, and performance of project management competence

Through the aforementioned literature exploration and

analysis, this study summarizes and edits the "Draft Questionnaire about Adults' Self-directed Learning, Learning Effectiveness and Performance of Project Management Competence," and adopts a 5-point Likert Scale, which items include 5 points for "Very Consistent," 4 points for "Consistent," 3 points for "Neutral," 2 points for "Inconsistent," and 1 point for "Very inconsistent." Adult education practitioners, scholars and experts in the field of adult education are hired as experts to review the draft questionnaire of this study. In terms of adult education practitioners, this study employs two teachers from each of the following adult education institutes, the Open University, Community University, Kaohsiung Tribal College, Labor College Kaohsiung and other adult education institutions, for a total of 8 teachers. Secondly, this study hires scholars and experts from the fields of adult education and project management for a total of 7 scholars and experts from the Open University of Kaohsiung, National Pingtung University, National Kaohsiung Normal University, National Chung Cheng University, Chang Jung Christian University, Aletheia University and the Taiwan Project Management Association, who had engaged in research into adult education or project management. Therefore, a total of 15 persons served as experts for reviewing the draft questionnaire of this study.

After the draft questionnaire was reviewed by experts, questionnaire pre-testing was conducted. A total of 200 pre-test questionnaires were distributed and a total of 174 valid questionnaires collected. The data of the collected questionnaires were used for project analysis and to establish validity and reliability. The "Questionnaire Scale regarding Adults' Self-directed Learning, Learning Effectiveness and Performance of Project Management Competence" of this questionnaire has a clear theoretical basis and model. Therefore, regarding the validity analysis of this questionnaire, LISREL software is employed for Confirmatory Factor Analysis (CFA) of the structural equation model. The factor model for internal structure is understood by referring to the perspectives of structural equation in Chiu (2003) and Wu (2006). Regarding the reliability analysis of this study, SPSS software is used for Cronbach's α analysis in order to determine the internal consistency of the questions at various levels.

Results of preparing the questionnaire regarding the overview of adults' self-directed learning, learning effectiveness, and performance of project management competence

This study analyzes the results through expert validity and retains a total of 65 questions regarding 11 dimensions for a total of 3 scales under the draft questionnaire of this study. In addition, some wordings in the questions were amended and the questions integrated before the aforesaid

questionnaire contents were produced. Subsequently, the contents of the questionnaire are subject to project analysis, CFA analysis and Cronbach's α analysis and the results are:

(1) Scale of adults' self-directed learning

This study analyzes the results through expert validity and retains a total of 15 questions regarding 3 dimensions, such as readiness to learn, active learning and creative learning in the draft questionnaire. In addition, the wordings of some questions were amended and the questions integrated before the aforesaid questionnaire contents were produced. Subsequently, the contents of the questionnaire are subject to project analysis, CFA analysis and Cronbach's α analysis, and the results are:

Regarding the critical ratio of project analysis in Table 2, the self-directed learning scale retains all 15 questions.

CFA analysis is carried out through LISREL software. Due to the large number of questions in the scale, the obtained results and the relationship roadmap cannot be presented herein; however, the degree of freedom and chi-square statistics of the overall model are specified in the analysis report. To be specific, the degree of freedom is 2,043, the chi-squared value is 11, 171.83 and the P value is 0.001. This suggests there are significant differences in the hypothetical model and the observed values. If other fitness indices, such as NFI, NNFI and CFI exceed 0.95, it indicates that each question and dimension structure is sound. Additionally, the results of Cronbach's α analysis show that, each dimension is greater than 0.86 and each question is higher than 0.78, suggesting rather high internal consistency of the various dimensions. The factor loadings and Cronbach's α value of the questions of each dimension are detailed as:

- 1) The factor loadings of questions for readiness to learn: The factor loadings of questions 1 to 5 are 0.57, 0.53, 0.53, 0.50 and 0.53, respectively. The Cronbach's α value of the overall dimension is 0.86 and the correlation values of all questions and total construct questions are greater than 0.60.
- 2) The factor loadings of questions for active learning: The factor loadings of questions 6 to 10 are 0.61, 0.62, 0.55, 0.64 and 0.61, respectively. The Cronbach's α value of the overall dimension is 0.88 and the correlation values of all questions and total construct questions are greater than 0.68.
3. The factor loadings of questions for creative learning: The factor loadings of questions 11 to 15 are 0.58, 0.53, 0.55, 0.55 and 0.52, respectively. The Cronbach's α value of the overall dimension is 0.87 and the correlation values of all questions and total construct questions are greater than 0.65.

(2) Scale of adults' learning effectiveness

Table 2: Summary of analysis of self-directed learning scale.

Question	Critical ratio	Remarks	Question	Critical Ratio	Remarks
1	11.21***	Retained	9	15.46***	Retained
2	12.22***	Retained	10	16.96***	Retained
3	12.84***	Retained	11	13.30***	Retained
4	16.16***	Retained	12	13.83***	Retained
5	14.56***	Retained	13	10.86***	Retained
6	14.31***	Retained	14	14.46***	Retained
7	16.96***	Retained	15	11.21***	Retained
8	15.46***	Retained			

***p<.001.

This study analyzes the results through expert validity and retains a total of 20 questions regarding 4 dimensions, such as satisfaction with services, knowledge improvement, knowledge application and competence performance in the draft questionnaire. In addition, some wordings in the questions are amended and the questions integrated before the aforesaid questionnaire contents are produced. Subsequently, the contents of the questionnaire are subject to project analysis, CFA analysis and Cronbach's α analysis, and the results are as follows: Regarding the critical ratio of project analysis in Table 3, the scale of adults' learning effectiveness retains all 20 questions.

CFA analysis is carried out through LISREL software. Due to the large number of questions in the scale, the obtained results and relationship roadmap cannot be presented herein; however, the degree of freedom and chi-square statistics of the overall model are specified in the analysis report. To be specific, the degree of freedom is 2,043, the chi-squared value is 11, 171.83 and the P value is 0.001, which suggests there are significant differences in the hypothetical model and the observed values. If other fitness indices, such as NFI, NNFI and CFI exceed 0.95, it indicates that each question and dimension structure is sound. Additionally, the results of Cronbach's α analysis show each dimension is greater than 0.85 and each question is higher than 0.80, suggesting rather high internal consistency of the various dimensions. The factor loadings and Cronbach's α values of questions in each dimension are detailed as follows:

1. The factor loadings of questions regarding satisfaction with service: The factor loadings of questions 01 to 05 are 0.60, 0.61, 0.56, 0.57 and 0.60, respectively. The Cronbach's α value of the overall dimension is 0.88 and the correlation values of all questions and total construct questions are greater than 0.63.
2. The factor loadings of questions for knowledge improvement: The factor loadings of questions 06 to 10 are 0.56, 0.52, 0.51, 0.50 and 0.52, respectively. The Cronbach's α value of the overall dimension is 0.86 and the correlation values of all questions and total construct

questions are greater than 0.58.

3. The factor loadings of questions for knowledge application: The factor loadings of questions 11 to 15 are 0.57, 0.54, 0.55, 0.55 and 0.53, respectively. The Cronbach's α value of the overall dimension is 0.87 and the correlation values of all questions and total construct questions are greater than 0.60.
4. The factor loadings of questions for competence performance: The factor loadings of questions 16 to 20 are 0.52, 0.50, 0.51, 0.49 and 0.52, respectively. The Cronbach's α value of the overall dimension is 0.87 and the correlation values of all questions and total construct questions are greater than 0.56.

(3) Scale of adults' performance of project management competence

This study analyzes the results through expert validity and retains a total of 30 questions regarding 4 dimensions, such as project initiation, project planning, project monitoring and control, and project closure in the draft questionnaire. In addition, the wordings of some questions are amended and the questions integrated before the aforesaid questionnaire contents are produced. Subsequently, the contents of the questionnaire are subject to project analysis, CFA analysis and Cronbach's α analysis, and the results are as follows:

Regarding the critical ratio of project analysis in Table 4, the scale of adults' learning effectiveness retains all 30 questions.

CFA analysis is carried out through LISREL software. Due to the large number of questions in the scale, the obtained results and relationship roadmap cannot be presented herein; however, the degree of freedom and chi-square statistics of the overall model are specified in the analysis report. To be specific, the degree of freedom is 2,043, the chi-squared value is 11, 171.83 and the P value is 0.001, which suggests there are significant differences in the hypothetical model and the observed values. If other fitness indices, such as NFI, NNFI and CFI exceed 0.95, it indicates that each question and dimension structure is sound. Additionally, the results of Cronbach's α analysis

Table 3: Summary of analysis of adults' learning effectiveness scale.

Question	Critical ratio	Remarks	Question	Critical Ratio	Remarks
1	10.77***	Retained	11	18.35***	Retained
2	10.71***	Retained	12	16.96***	Retained
3	13.18***	Retained	13	18.72***	Retained
4	13.22***	Retained	14	17.16***	Retained
5	11.26***	Retained	15	17.77***	Retained
6	14.91***	Retained	16	20.98***	Retained
7	16.12***	Retained	17	17.07***	Retained
8	18.12***	Retained	18	18.33***	Retained
9	20.54***	Retained	19	22.68***	Retained
10	18.26***	Retained	20	20.35***	Retained

***p<.001.

Table 4: Summary of analysis of adults' performance of project management competence scale.

Question	Critical ratio	Remarks	Question	Critical ratio	Remarks
1	24.40***	Retained	16	20.09***	Retained
2	20.83***	Retained	17	21.35***	Retained
3	21.47***	Retained	18	21.04***	Retained
4	23.58***	Retained	19	19.61***	Retained
5	25.30***	Retained	20	21.04***	Retained
6	23.21***	Retained	21	19.61***	Retained
7	21.47***	Retained	22	21.04***	Retained
8	24.34***	Retained	23	18.72***	Retained
9	25.48***	Retained	24	20.83***	Retained
10	25.83***	Retained	25	21.86***	Retained
11	24.74***	Retained	26	27.97***	Retained
12	29.47***	Retained	27	26.38***	Retained
13	22.09***	Retained	28	29.47***	Retained
14	24.00***	Retained	29	24.74***	Retained
15	22.92***	Retained	30	26.38***	Retained

***p<.001.

show that each dimension is greater than 0.87 and each question is higher than 0.81, suggesting rather high internal consistency of the various dimensions. The factor loadings and Cronbach's α values of the questions in each dimension are detailed as follows:

1. The factor loadings of questions for project initiation: The factor loadings of questions 01 to 05 are 0.62, 0.61, 0.58, 0.60, and 0.57, respectively. The Cronbach's α value of the overall dimension is 0.88 and the correlation values of all questions and total construct questions are greater than 0.66.
2. The factor loadings of questions for project planning: The factor loadings of questions 06 to 15 are 0.58, 0.57, 0.55, 0.53, 0.55, 0.54, 0.55, 0.56, 0.53 and 0.54, respectively. The Cronbach's α value of the overall

dimension is 0.87, and the correlation values of all questions and total construct questions are greater than 0.62.

3. The factor loadings of questions for project monitoring and control: The factor loadings of questions 16 to 25 are 0.54, 0.55, 0.56, 0.57, 0.54, 0.55, 0.58, 0.57, 0.55 and 0.55, respectively. The Cronbach's α value of the overall dimension is 0.87 and the correlation values of all questions and total construct questions are greater than 0.62.
4. The factor loadings of questions for project closure: The factor loadings of questions 26 to 30 are 0.58, 0.57, 0.60, 0.61 and 0.62, respectively. The Cronbach's α value of the overall dimension is 0.88 and the correlation values of all questions and total construct questions are greater than 0.65.

RESULTS

This study completes a formal "Questionnaire Scale regarding Adults' Self-directed Learning, Learning Effectiveness and Performance of Project Management Competence." Subsequently, this study uses cluster random sampling to sample 800 adults with learning experience in project management courses from the Kaohsiung Tribal College, Open University, Community University, Labor College Kaohsiung, College of Continuing and Extension Education and other adult education institutions for questionnaire survey. A total of 632 valid samples were collected. After the collection of questionnaires, descriptive statistics, t-testing, one-way ANOVA, regression analysis and other statistical analysis were carried out.

Results of descriptive statistics

In terms of gender

Among the valid samples, 278 samples are males, accounting for 44.0% of the total respondents, while 354 samples are females, representing 56.0% of the total respondents, thus, the proportion of females was higher than that of males.

In terms of age

Regarding age distribution, the majority of samples are aged 21 to 40, totaling 316 people and accounting for 50.0% of all respondents. The second largest group is aged 41 to 60, totaling 268 people and taking up 42.4%. The remaining samples are aged more than 61 (4.6%) and less than 20 (inclusive) (3.0%).

In terms of educational background

In terms of educational background, the majority of samples are graduates from vocational high schools, totaling 310 people and accounting for 49.1% of the total sample, followed by graduates from colleges and universities, totaling 219 people and making up 34.7%. The remaining samples are postgraduates (12.8%), junior high school graduates (inclusive), and below (3.5%).

In terms of occupation

In terms of occupational distribution, the largest numbers of samples are engaged in industrial and commercial service industries, totaling 421 people and representing 66.6%. The second largest number of samples worked in the information technology industry, totaling 82 people and accounting for 13.0% of the total sample. The

remaining samples worked in the manufacturing industry (10.6%), serve as government civil servants (including civil servants from the army, civil service, education, police and fire-fighting) (7.8%), or work in agriculture, forestry, fisheries, and animal husbandry (2.1%), etc.

In terms of position

Regarding occupational distribution, the largest numbers of samples were employees, amounting to 473 people and accounting for 74.8% of all samples. The second largest numbers of samples are responsible persons in organizations, totaling 80 people and constituting 12.7% of all samples. Finally, a total of 79 samples are department heads, taking up 12.5% of all samples.

In terms of organizational history

Regarding the distribution of organizational history, the largest number of samples work for organizations of more than 21 years, totaling 243 and accounting for 38.4% of all samples. The second largest numbers of samples work for organizations of less than 5 years (inclusive), totaling 171 and accounting for 27.1% of all samples. Additionally, 145 samples work for organizations of 11 to 20 years, constituting 22.9% of all samples, while 73 samples work for organizations of 6 to 10 years, representing 11.6% of all samples.

In terms of organizational scale

Regarding the distribution of organizational scale, most samples work for organizations of less than 50 people, amounting to 298 people and accounting for 47.2% of all samples. Besides, 202 samples work for organizations of 201 people, constituting 47.2% of all samples. The remaining samples work for organizations of 101 to 200 people (12.7%) and of 51 to 100 people (8.2%).

Status quo of adults' self-directed learning, learning effectiveness, and performance of project management competence

The status quo of adults' self-directed learning, learning effectiveness and performance of project management competence, averages and standard deviation analysis and statistical results of all dimensions are detailed in Tables 5, 6 and 7. It can be learned from Table 5 that, the averages of in-service adult learners' self-directed learning is more than 4.4 times that of all other dimensions, indicating that in-service adult learners have great self-directed learning performance. It can be observed from Table 6 that, the

Table 5: Averages and standard deviation of self-directed learning of in-service adult learners in all dimensions.

All dimensions of in-service adult learners' self-directed learning	Average	Standard deviation	Number of questions
Readiness to learn	4.62	0.52	5
Active learning	4.47	0.63	5
Creative learning	4.43	0.59	5
Overall dimensions of self-directed learning	4.51	0.54	15

N=632.

Table 6: Averages and standard deviation of learning effectiveness of in-service adult learners of all dimensions.

All dimensions of in-service adult learners' learning effectiveness	Average	Standard deviation	Number of questions
Satisfaction with service	4.60	0.57	5
Knowledge improvement	4.47	0.59	5
Knowledge application	4.47	0.59	5
Competence performance	4.10	0.78	5
Overall dimensions of learning effectiveness	4.40	0.56	20

N=632.

averages of in-service adult learners' self-directed learning effectiveness is more than 4.10 times that of all other dimensions, suggesting that in-service adult learners have great self-directed learning effectiveness. In addition, it can be seen from Table 7 that the averages of in-service adult learners' project management competence is more than 4.10 times that of all other dimensions, demonstrating that in-service adult learners have great performance in project management competence.

Variance analysis of social background variables in adults' self-directed learning, learning effectiveness, and performance of project management competence

Difference analysis of gender

T-testing is employed to compare the different perceptions of male and female in-service adult learners in self-directed learning, learning effectiveness and performance of project management competence. It can be learned from the statistical results that, different genders produce significant differences in adults' competence performance ($t = 2.20$, $P = 0.02$), project initiation ($t = 2.74$, $P = 0.01$), project planning ($t = 3.19$, $P = 0.01$), project monitoring and control ($t = 3.21$, $P = 0.01$), project closure ($t = 2.85$, $P = 0.01$) and the overall dimensions of performance of project management competence ($t = 3.15$, $P = 0.01$). All factor averages of males are higher than those of females. It can be learned from the aforementioned results that, in-service adult male learners' learning effectiveness of competence

performance and perceptions of project management competences of all dimensions are significantly higher than those of in-service adult female learners.

Difference analysis of age

One-way ANOVA is used to compare the different perceptions of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners of different ages. The statistical results show that, there is no significant difference in self-directed learning, learning effectiveness, performance of project management competence, or other dimensions ($P > 0.05$). This indicates that the perceptions of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners of different ages are rather consistent.

Difference analysis of educational background

One-way ANOVA is used to compare the different perceptions of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners of different educational backgrounds. The statistical results show that, there is no significant difference in self-directed learning, learning effectiveness, performance of project management competence, or other dimensions ($P > 0.05$). This indicates that the perceptions of self-directed

Table 7: Averages and standard deviation of project management competence of in-service adult learners of all dimensions.

All dimensions of in-service adult learners' performance of project management competence	Average	Standard deviation	Number of questions
Project initiation	4.12	0.82	5
Project planning	4.10	0.84	10
Project monitoring and control	4.11	0.81	10
Project closure	4.10	0.42	5
Overall dimensions of project management competence	4.10	0.80	30

N=632.

learning, learning effectiveness and performance of project management competence of in-service adult learners of different educational backgrounds are rather consistent.

Difference analysis of occupation

One-way ANOVA is used to compare the different perceptions of self-directed learning, learning effectiveness, and performance of project management competence of in-service adult learners of different occupations. The statistical results show that, there is no significant difference in self-directed learning, learning effectiveness, performance of project management competence, or other dimensions ($P > 0.05$). This indicates that the perceptions of self-directed learning, learning effectiveness, and performance of project management competence of in-service adult learners of different occupations are rather consistent.

Difference in analysis of positions

One-way ANOVA is used to compare the different perceptions of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners of different positions. It can be learned from the statistical results that, there are significant differences in perceptions of readiness to learn ($F = 4.17$, $P = 0.02$), active learning ($F = 8.41$, $P = 0.001$), creative learning ($F = 4.94$, $P = 0.01$) and overall dimension of self-directed learning ($F = 6.71$, $P = 0.003$). Moreover, Scheffe's multiple post-hoc comparative analysis found that, the perceived factor averages of in-service adult learners whose position is the responsible persons of organizations are significantly higher than those of in-service adult learners whose position is employees in terms of readiness to learn, active learning, creative learning, and the overall dimension of self-directed learning. It can be observed from the aforementioned results that the perception of self-directed learning of in-service adult learners whose position is employees are relatively low.

In-service adult learners of different positions have significant differences in perceptions of knowledge improvement ($F = 6.11$, $P = 0.004$), knowledge application ($F = 6.11$, $P = 0.002$), competence performance ($F = 7.46$, $P = 0.001$), and the overall dimension of learning effectiveness ($F = 6.72$, $P = 0.001$). Moreover, Scheffe's multiple post-hoc comparative analysis found that, the perceived factor averages of in-service adult learners whose position is the responsible persons of organizations are significantly higher than those of in-service adult learners whose position is employees, in terms of knowledge improvement, knowledge application, competence performance, and the overall dimension of learning effectiveness. Additionally, the perceived factor averages of in-service adult learners whose position is the responsible persons of organizations are significantly higher than those of in-service adult learners whose position is department heads, in terms of knowledge improvement, knowledge application, competence performance, and the overall dimension of learning effectiveness. It can be seen from the above results that the perceptions of self-directed learning of in-service adult learners whose position is employees and department heads are relatively low.

In-service adult learners of different positions have significant differences in the perceptions of project initiation ($F = 10.72$, $P = 0.001$), project planning ($F = 8.54$, $P = 0.001$), project management ($F = 8.55$, $P = 0.001$), project closure ($F = 6.48$, $P = 0.001$) and the overall dimension of performance of project management competence ($F = 8.88$, $P = 0.001$). Moreover, Scheffe's multiple post-hoc comparative analysis found that, the perceived factor averages of in-service adult learners whose position is the responsible persons of organizations are significantly higher than those of in-service adult learners whose position is employees in terms of project initiation, project planning, project monitoring and control, project closure and performance of project management competence. Additionally, the perceived factor average of in-service adult learners whose position is the responsible persons of organizations are significantly higher than those of in-service adult learners whose position is department heads in terms of project initiation. It can be

seen from the aforementioned results that the perceptions of performance of project management competence of in-service adult learners whose position is employees and department heads are relatively low.

Difference in analysis of organizational history

One-way ANOVA is used to compare the different perceptions of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners of different positions. It can be learned from the statistical results that there are significant differences in perceptions of readiness to learn ($F = 4.85, P = 0.003$), active learning ($F = 4.64, P = 0.00$), creative learning ($F = 4.14, P = 0.01$) and the overall dimension of self-directed learning ($F = 5.15, P = 0.003$). Moreover, Scheffe's multiple post-hoc comparative analysis found that the perceived factor averages of in-service adult learners who work for organizations of more than 21 years are significantly higher than those of in-service adult learners who work for organizations of less than 5 years in terms of readiness to learn, active learning, creative learning and the overall dimension of self-directed learning. It can be observed from the aforementioned results that the perceptions of self-directed learning of in-service adult learners who work for organizations of less than 5 years are relatively low.

In-service adult learners working for organizations with different organizational histories have significant differences in the perceptions of satisfaction with service ($F = 2.68, P = 0.04$), knowledge improvement ($F = 4.32, P = 0.01$), knowledge application ($F = 4.32, P = 0.01$), competence performance ($F = 2.92, P = 0.03$) and the overall dimension of learning effectiveness ($F = 4.32, P = 0.01$). Moreover, Scheffe's multiple post-hoc comparative analysis found that the perceived factor averages of in-service adult learners who work for organizations of more than 21 years are significantly higher than those of in-service adult learners who work for organizations of less than 5 years in terms of knowledge improvement, knowledge application and the overall dimension of learning effectiveness. It can be observed from the aforementioned results that the perceptions of learning effectiveness of in-service adult learners who work for organizations of less than 5 years are relatively low.

In-service adult learners working for organizations of different organizational histories have significant differences in the perceptions of project initiation ($F = 4.88, P = 0.005$), project planning ($F = 4.41, P = 0.006$), project monitoring and control ($F = 4.87, P = 0.006$), project closure ($F = 5.29, P = 0.003$) and the overall dimension of performance of project management competence ($F = 5.00, P = 0.004$). Moreover, Scheffe's multiple post-hoc comparative analysis found that, the

perceived factor averages of in-service adult learners who work for organizations of more than 21 years are significantly higher than those of in-service adult learners who work for organizations of less than 5 years, in terms of project initiation, project planning, project monitoring and control, project closure, and performance of project management competence. It can be observed from the aforementioned results that the perceptions of performance of project management competence of in-service adult learners who work for organizations of less than 5 years are relatively low.

Difference analysis of organizational scale

One-way ANOVA is used to compare the different perceptions of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners of different organizational scales.

The statistical results show that there is no significant difference in self-directed learning, learning effectiveness, performance of project management competence, or other dimensions ($P > 0.05$). This indicates that the perceptions of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners of different organizational scales are rather consistent.

Correlation analysis of adults' self-directed learning, learning effectiveness, and performance of project management competence

Pearson's product-moment correlation coefficient is employed to analyze the correlation and degree of in-service adult learners' in the dimensions of self-directed learning, learning effectiveness and performance of project management competence. Tables 8, 9 and 10 shows the relevant product-moment correlation table of in-service adult learners' self-directed learning, learning effectiveness and dimensions of performance of project management competence. The statistical results illustrate that all dimensions and the overall dimension of performance of project management competence of in-service adult learners' self-directed learning, learning effectiveness, and performance of project management competence are moderately or highly positively correlated (the correlation coefficients are above 0.50). This indicates that the higher the degree of in-service adult learners' self-directed learning performance, the better the degree of learning effectiveness and performance of project management competence. Moreover, the higher the perceived degree of in-service adult learners' learning effectiveness, the better the performance of project management competence.

Table 8: Product-moment correlation analysis of in-service adult learners' in all dimensions of self-directed learning and learning effectiveness.

Correlation coefficients		All dimensions of learning effectiveness				
		Satisfaction with service	Knowledge improvement	Knowledge application	Competence performance	Overall dimension of learning effectiveness
All dimensions of self-directed learning	Readiness to learn	0.77***	0.74***	0.74***	0.53***	0.76***
	Active learning	0.70***	0.78***	0.78***	0.63***	0.80***
	Creative learning	0.67***	0.75***	0.75***	0.64***	0.78***
	Overall dimension of self-directed learning	0.75***	0.81***	0.81***	0.65***	0.84***

***p<0.001; N=632.

Table 9: Product-moment correlation analysis of in-service adult learners' in all dimensions of self-directed learning and performance of project management competence.

Correlation coefficients		All dimensions of project management competence				
		Project initiation	Project planning	Project monitoring	Project closure	Overall dimension of project management competence
All dimensions of self-directed learning	Readiness to learn	0.57***	0.52***	0.53***	0.54***	0.55***
	Active learning	0.68***	0.64***	0.63***	0.65***	0.66***
	Creative learning	0.66***	0.64***	0.64***	0.64***	0.66***
	Overall dimension of self-directed learning	0.68***	0.65***	0.65***	0.66***	0.67***

*** p < 0. 001; N=632.

Table 10: Product-moment correlation analysis of in-service adult learners' in all dimensions of learning effectiveness and performance of project management competence.

Correlation coefficients		All dimensions of project management competence				
		Project initiation	Project planning	Project monitoring	Project closure	Overall dimension of project management competence
All dimensions of learning effectiveness	Satisfaction with service	0.52***	0.50***	0.50***	0.50***	0.51***
	Knowledge improvement	0.71***	0.69***	0.66***	0.68***	0.70***
	Knowledge application	0.71***	0.69***	0.66***	0.68***	0.70***
	Competence performance	0.83***	0.80***	0.77***	0.76***	0.81***
	Overall dimension of learning effectiveness	0.79***	0.76***	0.74***	0.74***	0.78***

***p< 0.001; N=632.

Analysis of predictive power of in-service adult learners' self-directed learning and learning effectiveness in performance of project management competence

In terms of the predictive power in project initiation

Stepwise multiple regression analysis is adopted to analyze the predictive power of all the dimensions of in-service adult learners' self-directed learning and learning effectiveness in project initiation. According to Table 11, the criterion variables of project initiation, competence

performance ($t = 21.10$, $P = 0.001$), active learning ($t = 5.60$; $P = 0.003$), knowledge improvement ($t = 4.78$; $P = 0.004$) and satisfaction with service ($t = 2.59$, $P = 0.001$) reach a significant level. Specifically, the variable competence performance produced the greatest impact on project initiation, followed by active learning. The standardized regression coefficients of the four independent variables are all positive, indicating that their impacts on project initiation are positive. Tolerance ranges from 2 to 3, while the variance inflation factors (VIF) are less than 5 and not more than the evaluation index of 10, suggesting that the multivariate collinearity of

Table 11: Analysis of predictive power of in-service adult learners' self-directed learning and learning effectiveness in project initiation.

Variable	Unstandardized coefficient		Standardized coefficient	t	P	Collinearity statistics	
	Estimated value of β	Standard error	Beta allocation			Tolerance	VIF
Constant	1.30	0.71	-	1.84	0.04	-	-
Competence performance	0.64	0.03	0.62	21.10	0.001	0.49	2.05
Active learning	0.25	0.04	0.19	5.60	0.003	0.35	2.83
Knowledge improvement	0.27	0.06	0.20	4.78	0.004	0.25	4.05
Satisfaction with service	0.12	0.05	0.10	2.59	0.01	0.38	2.61

Dependent variable: Project Initiation; R^2 : 0.74; * $p < 0.05$ ** $p < 0.01$.

independent variables in the regression equations is not obvious.

In terms of predictive power in project planning

Stepwise multiple regression analysis is employed to analyze predictive power of all the dimensions of in-service adult learners' self-directed learning and learning effectiveness in project planning. According to Table 12, in the criterion variables of project initiation, competence performance ($t = 18.18$, $P = 0.001$), knowledge improvement ($t = 4.85$; $P = 0.003$), creative learning ($t = 2.58$; $P = 0.01$), satisfaction with service ($t = 3.50$, $P = 0.004$) and active learning ($t = 2.22$; $P = 0.03$) reach a significant level. Specifically, the variable of competence performance produced the greatest impact on project planning, followed by knowledge improvement. The standardized regression coefficients of the five independent variables are all positive, indicating that their impacts on project planning are positive. Tolerance ranges from 2 to 3, while variance inflation factors (VIF) are less than 5 and not more than the evaluation index of 10, suggesting that the multivariate collinearity of independent variables in the regression equations is not obvious.

In terms of predictive power in project monitoring and control

Stepwise multiple regression analysis is adopted to analyze the predictive power of all the dimensions of in-service adult learners' self-directed learning and learning effectiveness in project monitoring and control. According to Table 13, regarding the criterion variables of project monitoring and control, competence performance ($t = 15.27$, $P = 0.001$), overall self-directed learning ($t = 4.50$; $P = 0.005$), knowledge improvement ($t = 3.10$; $P = 0.006$), and readiness to learn ($t = 2.65$, $P = 0.01$) reach a significant level. Specifically, the variable of competence performance produced the greatest impact on project monitoring and control, followed by overall self-directed learning. The

standardized regression coefficients of the four independent variables are all positive, indicating that their impacts on project monitoring and control are positive. Tolerance ranges from 2 to 3, and the variance inflation factors (VIF) are not more than the evaluation index of 10, suggesting that the multivariate collinearity of independent variables in the regression equations is not obvious.

In terms of predictive power in project closure

Stepwise multiple regression analysis is adopted to analyze the predictive power of all the dimensions of in-service adult learners' self-directed learning and learning effectiveness in project closure. According to Table 14, regarding the criterion variable of project closure, competence performance ($t = 14.06$, $P = 0.001$), overall self-directed learning ($t = 5.25$; $P = 0.003$), knowledge application ($t = 4.86$; $P = 0.003$), satisfaction with service ($t = 2.76$, $P = 0.01$) and readiness to learn ($t = 2.60$, $P = 0.01$) reach a significant level. Specifically, the variable competence performance produced the greatest impact on project closure, followed by overall self-directed learning. The standardized regression coefficients of the five independent variables are all positive, indicating that their impacts on project closure are positive. Tolerance ranges from 2 to 3, and the variance inflation factors (VIF) are not more than the evaluation index of 10, suggesting that the multivariate collinearity of independent variables in the regression equations is not obvious.

In terms of predictive power in overall dimensions of performance of project management competence

Stepwise multiple regression analysis is adopted to analyze predictive power of the dimensions of the in-service adult learners' self-directed learning and learning effectiveness in overall dimensions of performance of project management competence. According to Table 15,

Table 12: Analysis of predictive power of in-service adult learners' self-directed learning and learning effectiveness in project planning.

Variable	Unstandardized coefficient		Standardized coefficient	t	P	Collinearity statistics	
	Estimated value of β	Standard error	Beta allocation			Tolerance	VIF
(constant)	3.04	1.63	-	1.87	0.04	-	-
Competence performance	1.27	0.07	0.59	18.18	0.001	0.48	2.11
Knowledge improvement	0.62	0.13	0.22	4.85	0.003	0.24	4.16
Creative learning	0.30	0.12	0.11	2.58	0.01	0.29	3.43
Satisfaction with service	0.38	0.11	0.13	3.50	0.004	0.38	2.65
Active learning	0.26	0.12	0.10	2.22	0.03	0.27	3.77

Dependent variable: Project planning; R^2 : 0.69; * $p < 0.05$ ** $p < 0.01$.

Table 13: Analysis of predictive power of in-service adult learners' self-directed learning and learning effectiveness in project monitoring and control.

Variable	Unstandardized coefficient		Standardized coefficient	t	P	Collinearity statistics	
	Estimated value of β	Beta allocation	Beta allocation			Tolerance	VIF
(Constant)	1.18	1.78		0.67	0.50		
Competence performance	1.12	0.07	0.54	15.27	0.001	0.47	2.13
Overall self-directed learning	0.34	0.08	0.34	4.50	0.005	0.10	9.57
Knowledge improvement	0.38	0.12	0.14	3.10	0.006	0.29	3.47
Readiness to learn	0.53	0.20	0.17	2.65	0.01	0.14	6.93

Dependent variable: Project monitoring and control; R^2 : 0.63; * $p < 0.05$ ** $p < 0.01$.

Table 14: Analysis of predictive power of in-service adult learners' self-directed learning and learning effectiveness in project closure.

Variable	Unstandardized coefficient		Standardized coefficient	t	P	Collinearity statistics	
	Estimated value of β	Beta allocation	Beta allocation			Tolerance	VIF
(Constant)	1.09	.91		1.20	0.23		
Competence performance	0.52	0.04	0.49	14.06	0.001	0.47	2.14
Overall self-directed learning	0.20	0.04	0.39	5.25	0.003	0.10	9.58
Knowledge application	0.33	0.07	0.24	4.86	0.003	0.24	4.18
Satisfaction with service	0.17	0.06	0.11	2.76	0.01	0.34	2.94
Readiness to learn	0.27	0.10	0.17	2.60	0.01	0.14	7.29

Dependent variable: Project closure; R^2 : 0.64; * $p < 0.05$ ** $p < 0.01$.

regarding the criterion variable of overall dimensions of performance of project management competence, competence performance ($t = 18.12$, $P = 0.001$), overall self-directed learning ($t = 5.31$; $P = 0.003$), knowledge application ($t = 4.80$; $P = 0.003$), readiness to learn ($t = 2.84$, $P = 0.01$), and satisfaction with service ($t = 2.55$, $P = 0.01$) reach a significant level. Specifically, the variable of competence performance produced the greatest impact on the overall dimensions of performance of project

management competence, followed by overall self-directed learning. The standardized regression coefficients of the five independent variables are all positive, indicating that their impacts on the overall dimensions of performance of project management competence are positive. Tolerance ranges from 2 to 3 and variance inflation factors (VIF) are not more than the evaluation index of 10, suggesting that the multivariate collinearity of independent variables in the regression equations is not obvious.

Table 15: Analysis of predictive power of in-service adult learners' self-directed learning and learning effectiveness in the overall dimensions of performance of project management competence.

Variable	Unstandardized coefficient		Standardized coefficient	t	P	Collinearity statistics	
	Estimated value of β	Beta allocation	Beta allocation			Tolerance	VIF
(Constant)	5.00	4.79		1.04	0.30		
Competence performance	3.52	0.19	0.57	18.12	0.001	0.47	2.14
Overall self-directed learning	1.05	0.20	0.35	5.31	0.003	0.10	9.58
Knowledge application	1.71	0.36	0.21	4.80	0.003	0.24	4.18
Readiness to learn	1.52	0.54	0.17	2.84	0.01	0.14	7.29
Satisfaction with service	0.81	0.32	0.10	2.55	0.01	0.34	2.94

Dependent variable: Project closure; R^2 : 0.64; * $p < 0.05$ ** $p < 0.01$.

CONCLUSION AND RECOMMENDATIONS

Current observations show sound study results for in-service adult learners' self-directed learning, learning effectiveness and performance of project management competence. Furthermore, the higher the degree of in-service adult learners' self-directed learning performance, the higher is the degree of learning effectiveness and performance of project management competence. In addition, the higher the perceived degree of in-service adult learners' learning effectiveness, the better the performance of project management competence; in-service adult learners' learning effectiveness perception of competence performance has positive and significant predictive power of their performance in project management competence.

Consequently, adult education institutions providing in-service training to adult learners should adopt performance-oriented training models and actively introduce the Talent Development Quality Management System (TTQS). Additionally, they should determine the adult learners' demands for education and training based on gap analysis of their learning demands and competence. They should plan, design, implement and monitor education and training activities based on the learners' demands for education and training, thus, effectively assisting them to enhance their work performance, get promoted, improve their salary and welfare and enhance their return on investment of the departments and organizations they work for. As a result, the learners' performance in project initiation, project planning, project monitoring and control, project closure and other project management competences can be improved.

Social variables of in-service adult learners also show differences in their self-directed learning, learning effectiveness and performance of project management competence. Regarding gender difference performance, all dimensions of in-service adult male learners' learning effectiveness in competence performance and perceptions of project management competences are significantly

higher than those of in-service adult female learners. Therefore, when planning education and training courses for in-service training, adult education institutions should focus on assisting in-service adult female learners in order to increase their learning effectiveness and competence performance. Moreover, through the employing organizations, they can discuss, visit, coach, and track the learners work performance after school; and in this way, determine learners' competence gaps and training demands, design adaptive education and training courses for in-service adult female learners, boost their learning effectiveness of competence performance and improve their performance of project management competence in order to achieve the expected goals of further study.

The perceptions of self-directed learning, learning effectiveness and performance of project management competence of in-service adult learners whose current position is a basic employee are lower than those of learners who are responsible persons of organizations. In addition, the perceptions of learning effectiveness and performance of project management competence of department heads are lower than those of responsible persons of organizations. Therefore, when planning education and training courses for in-service training, adult education institutions should pay special attention to employees and department heads, learn about their learning demands, determine proper learning methods and analyze the details of their competence gaps in order to determine teaching activity patterns, as well as, the contents of the education and training courses for in-service learners. They should actively assist learners in readiness to learn, active learning, creative learning, self-directed learning and other activity arrangements.

Meanwhile, through adaptive courses and teaching activities, they can improve the learners' learning ability, effectively apply their acquired knowledge, enhance their competence performance and thus, increase learning effectiveness. Such activities can also improve the learners' competence performance in project initiation, project planning, project monitoring and control, project closure

and other project management activities, as well as motivate them to achieve their work tasks and objectives.

The results of this study illustrate that the history and development of the organizations where in-service adult learners work will also affect their performance of self-directed learning, learning effectiveness and project management competence. The perceptions of readiness to learn, active learning, creative learning and other self-directed learning performances, knowledge improvements, knowledge applications and other learning effectiveness, as well as, the performance of project management competence in project initiation, project planning, project monitoring and control, and project closure of in-service adult learners who worked for organizations of less than 5 years are significantly higher than those of in-service adult learners who worked for organizations of more than 21 years.

Therefore, adult education institutions should identify the visions, strategies, goals and professional development needs of business operations and develop learners for new organizations with a history of less than 5 years. They should coach the learners in formulating a team, as well as individual learning programs, deliver the contents of a project management knowledge system through an appropriate curriculum and activity design, assist them when introducing the project management operation system in order to boost their performance in project management competence. Additionally, education institutions should help the in-service adult learners of new organizations to effectively improve their professional competence in the workplace and allow the organizations to jointly develop after-school action plans to assist the learners to effectively apply their acquired knowledge to work contexts and thus, nurture resources and motivation for sustainable development and gradually fulfill the work objectives and organizational vision.

In conclusion, attending a wide array of internal and external learning activities has become one of the most important tasks for current professionals to effectively address the rapid changes and developments of the workplace, not be overwhelmed by an intensely competitive workplace, and improve professional competence. The Workforce Development Agency, Ministry of Labor, put forward enterprises laborer improvements, investment programs for industrial talents and other programs, as well as, resources for the training, learning and growth of enterprises and professionals in order to enhance their competitive edge in the workplace. Hence, to effectively address workplace problems, in-service adult learners should actively devote themselves to and participate in all types of learning and training activities in order to learn to develop effective solutions and strategies.

Furthermore, adult education institutions should, as based on the present professional trend of project management, actively plan training courses for project

management, while simultaneously introducing a talent development quality management system (TTQS).

In addition, they should also adopt a performance-oriented training model in order to enhance learners' learning effectiveness, improve performance of project management competence and help the learners to attain their goals of developing a sustainable career.

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