Self-adjusting Learning Strategies of Preservice Teachers' Cross-disciplinary Teaching Professionalization: Adjusting 107 Curriculum Reform and Industry 4.0

Chun-Mei Chou, Chien-Hua Shen, Hsi-Chi Hsiao, Tsu-Chuan Shen, and Tsu-Chi Shen

***Abstract*—This study aims to design a self-adjusting learning strategy for the pre-service teachers' cross-disciplinary teaching professionalism in order to adjust to the 107 Curriculum Reform and Industry 4.0. Experimental teaching in a self-adjusting learning strategy training program is given herein. The teaching is aimed at exploring the impact of the course on pre-service teachers' cross-disciplinary teaching professionalism. The sample for the study included 64 pre-service teachers in an unequal pre- and post-test control group. Research tools included the cross-disciplinary teaching professional behavior scale. The conclusions were: 1. After the teaching, the pre-service teachers of the experimental group showed significant improvement in the areas of "curriculum development and design", "pro-teacher communication" and "professional leadership" in the cross-disciplinary teaching specialization. 2. Of the pre-service teachers in the experimental group, 87.2% had a positive attitude to self-adjustment curriculum teaching.**

***Index Terms*—Pre-service teacher, self-adjusting learning strategy, cross-disciplinary teaching professionalism.**

I. Introduction

The 107 curriculum reform addresses certain key areas: teachers who can target the skills field; a clear definition of the skills required to open up the job market; and the development of the skills needed to address the specific characteristics of regional industrial areas [1]. The results of graduates from the Ministry of Improvement/School Internship were used to assess teachers' ability in the classroom, their ability to design an industry-oriented curriculum, and to what extent they made good use of off-campus industrial resources. The teachers were also evaluated in terms of their practical teaching [1], [2].

Teachers play an important role in curriculum reform due to their knowledge of local industries and their teaching experience. They are able to integrate this knowledge with their experience in organizing their subject and developing teaching materials [3]. How teachers consider the organization of information and their personal ability to adjust teaching plans are important; it is from the perspective of the latter that the teaching profession needs to be explored in order to understand self-adjusting teaching strategies [4], [5]. Teachers use self-adjusting strategies to enhance their interpretation and reflection when developing the curriculum: they develop self-adjustment abilities in response to curriculum reforms. Learning strategies depend on teachers' self-reflection, their professional knowledge of their subject and their rich teaching experiences [6]-[8].

Self-regulation refers to individuals' ability to reflect on their own organization and to use their judgment regarding how best to perform an action and complete a task. The education of pre-service teachers includes a high degree of interdisciplinary specialization. Their active participation in curriculum reform and the completion of the work are considered to be effective in the process and in the ongoing education of teachers [9], [10].

Self-adjustment affects the individual's response to the environment. There are two psychological adjustment mechanisms for the development of teachers' inter-disciplinary teaching specialization: self-awareness and control belief. The former emphasizes the perception of "I" while the latter is the causal belief and action intention of "I can" [11], [12].

The development stage of the teacher's self-adjustment involves the physical and mental changes brought about by the transformation of individuals' consciousness in their teaching. This adjustment and change will be affected by the individual, school, culture and educational environments. The formation of self-adjustment of former teachers has a great influence [13]-[15].

Regulatory strategies, according to research, refer to the continuous adjustment of personal cognitive activities in order to improve performance. The adjustment strategy improves learners' performance by encouraging them to check and correct their behavior while doing homework [16]. The adjustment strategy includes planning, monitoring and resource management strategies: 1) planning strategies include goal setting and job analysis to help activate or prepare ideas related to prior knowledge. This helps learners to organize and understand textbooks. 2) Monitoring strategies include paying attention to reading, self-testing, and problem-solving. These activities can help learners understand and integrate previous knowledge. 3) Resource

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management strategies include allocating time and making the effort, the reading environment, peer learning, and seeking help [17]-[19]. The training of pre-service teachers to self-regulate their learning includes encouraging them to set learning goals and plans, assessing their own performance, using self-reward skills, establishing good time-management habits, and seeking help when encountering difficulties. Further, they are encouraged to make good use of the available social resources and information, retain records and archives, make good use of effective study skills, and construct strategies that pertain to their own learning environment [20], [21].

It is known that the development of different self-adjustment training strategies (as described above) is conducive to the implementation of interdisciplinary curriculum ideals and the practice of the professional development of teachers. The reflection and discipline that accompany the development of self-adjustment and professional knowledge and rich teaching experience encourage good use of self-linking ability; these have played an important role in cross-disciplinary curriculum integration and teaching ability and will help to develop a technical model in the future in response to 107 courses [22], [23]. As the introduction of self-adjustment mechanisms in the specialization of inter-disciplinary teaching in high schools is urgent, it is the motivation of this research. There are two aims for this study:

1) To integrate the "Self-adjusted Learning Theory" into the "Course Development and Design" and "Training Internship" subjects and to design an experimental teaching activity for "Self-adjustment Learning Strategies".
2) To carry out an experiment in teaching the self-adjustment learning strategy and analyze its effectiveness among technical high school pre-service teachers in the cross-disciplinary teaching specialization.

II. Methodology

A. Research Design and Structure

This study offers an experiment in teaching a self-adjusting learning strategy for the teaching profession. It makes use of quasi-experimental research with a non-prepared pre-test control group design (nonequivalent pre-test-post-test control group design). The design of the research is shown in Table I.

TABLE I: Design of the Control Group before and after the Unequal Group

Group	pretest	experimental processing	post-test
experiment group	TE1	X	TE2
control group	TC1	C	TC2

Note: TE1 and TE2: scores of pre-test and post-test of the experimental group
TC1 and TC2: scores of the pre-test and post-test of the control group
X: Teaching with self-adjusting learning strategy
C: Teaching without self-adjusting learning strategy

B. Research Object

The sample comprised 64 pre-service teachers who were in their second year of training at the technical high school teacher training center. There were 31 pre-service teachers in the experimental group and 33 in the control group. The experimental group applied a self-adjusted learning strategy during the flexible learning period while the control group did not do so. In order to enhance the professionalism of pre-service teachers in cross-disciplinary teaching and to help them adjust to the 107 curriculum reform, this study incorporates self-adjusted learning theory into the "Course Development and Design" and "Teaching Practice" subjects to design activities for the self-adjusting learning strategy. The course design and the design of the experiment, as well as conducting the experimental teaching were completed within a year, as was the analysis of the effectiveness of the trial and its benefits for pre-service teachers specializing in cross-disciplinary teaching.

C. Measure

The "Cross-disciplinary Teaching Specialization Scale" was used to analyze the changes in the teaching behavior of teachers' cross-disciplinary teaching. The content structure comprised "Education Practice", "Curriculum Development and Design", "Teaching Assessment" and "Communication with Parents", "Course Reform", "Professional Leadership" and "Environmental Reform" in Table II. Descriptive statistics and t-test analysis of the SPSS statistical analysis software were used to explore whether the self-adjustment teaching strategy improved the professional ability of pre-service teachers in cross-disciplinary teaching.

TABLE II: Factors, Number of Items, Validity and Reliability of Interdisciplinary Teaching Specialization Scale

Factor	No of items	Factor loading	Cronbach α	Total
Educational Practice	4	21.62	.91	
Curriculum Development and Design	4	17.31	.84	
Teaching Assessment	4	15.48	.83	.91
Parent-teacher communication	4	13.22	.92	
Professional leadership	4	11.12	.89	
Environmental reform transformation	4	10.98	.88	

D. Course Design and Implementation

1) The requirement was to assist technical high school teachers with self-adjusted learning in accordance with the 107-category specialization of interdisciplinary teaching. It was important to confirm the gap assessment based on the two-way checklist in carrying out the research. The development of the teaching model required planning and adjustment. The team involved with the design of the curriculum and the development of textbooks included five technical education curriculum experts, industry experts, teachers and researchers.
2) Based on the ASSURE instructional design model, this study uses Fink's (2011) integrated course design and the work of Hoof and Verkerk (2013) and Fosmire (2012). The teaching design principles integrated teaching

resources and the design of a self-adjustment curriculum into the learning strategy, the design of unit textbooks and teaching activities. After discussion, the experts determined the feasibility of the design of the teaching unit. The teaching materials were compiled according to the teaching objectives and evaluation criteria of the majority. The teaching materials and the teachers' manual for the trial were compiled and the teaching material was developed. After this, the teaching trial was held and evaluated, and the establishment of course materials carried out.

3) Self-adjustment strategy: The self-adjustment strategy aims to help teachers who specialize in cross-disciplinary teaching to consider the core concepts and enhance their skills. This establishes the sense of shared beliefs among members of the body that the special ability of each member can be combined in such a way that the required action is achieved. The self-adjustment strategy course in this study includes four levels: cognitive strategy, post-cognitive strategy, motivation belief management strategy, and environment and resource management strategy.
4) Experimental unit: Courses in the curriculum development and design include: (1) Introduction to 107 curriculum reform, thematic curriculum design, and special curriculum. (2) Practical teaching subjects include "How to make donuts", "Industry teachers' collaborative teaching partners", "Practical topics", and "Workplace experience camps".
5) The ASSURE instructional design includes: assessment of learners, statement of objectives, selection of methods, media and materials, and the use of media and materials. Six subjects that require learner participation as well as evaluation and revision are required for the experimental teaching.

E. Data Analysis

In this study, the group (divided into the experimental group and the control group) was used as the self-variation, and the scores of the subjects after the "Cross-disciplinary Teaching Specialization Scale" were changed. In addition, the pre-service teachers in the experimental group were included. The scores obtained were analyzed using SPSS as descriptive statistics, the regression homogeneity test, single factor covariate analysis, an independent sample t test, and a single sample t test.

III. Research Results and Analysis

The analysis of the effectiveness and satisfaction of the experimental teaching on the promotion of pre-service teachers in cross-disciplinary teaching is presented herein.

Before the cross-disciplinary teaching specialization, the score was taken as the common variable, the experimental process was the self-variation, and the post-test score was the dependent variable. Single factor covariate analysis was performed separately. Before the covariate analysis, the homogeneity test of the regression coefficients in the group needed to be carried out. If the "resonance of the regression coefficients within the group" yields results, the slopes of the groups are unequal: that is, the interaction has reached a significant level, indicating that the regression coefficient within the group is homogenous. It was unnecessary to conduct covariate analysis. In this case, the hypothesis of the homogeneity of the regression coefficients in the group was violated. This study adopted an independent sample t test to conduct the statistical analysis of the mean before and after measurement.

The results of the homogeneity test of the regression coefficient in the group are shown in Table III. From the results in the table, it can be noted that the interactions among the change of the education practice, the curriculum development and design, and the covariation of the curriculum reaches a significant level, indicating violation of the homogeneity of the regression coefficient within the group. Therefore, to analyze the effectiveness of the teaching, the comparison of educational practice, curriculum development and design performance was based on an independent sample t test.

TABLE III: Summary of Homogeneity Test of Regression Coefficient in Different Groups in the Self-adjusted Learning Strategy Group

	Source	SS	DF	MS	F	
Educational Practice	between	3.22	1	3.22	5.79	*
	error	99.67	179	.56		
Curriculum Development and Design	between	87.36	1	87.36	7.36	**
	error	2124.66	179	11.87		
Teaching Assessment	between	.43	1	.43	.26	
	error	301.49	179	1.68		
Parent-teacher communication	between	7.27	1	7.27	.63	
	error	2058.90	179	11.50		
Professional leadership	between	43.52	1	43.52	3.70	
	error	2104.41	179	11.76		
Environmental reform transformation	between	7.07	1	7.07	2.05	
	error	616.78	179	3.45		

*P<.05**P<.01

The independent sample t-test of education practice, curriculum development and cross-disciplinary teaching specialization before and after the design is shown in Table IV. The education practice, curriculum development and design of the pre-service teachers in the two groups did not reach a significant level in the before and after tests, indicating that they were processed experimentally. After that, those in the experimental group and those in the control group did not show significant differences in educational practice, curriculum development and design.

TABLE IV: Educational Practice, Curriculum Development and Average Difference before and after Design *t*-Test

	group	*M*	*t* alue
Educational Practice	experiment group	.07	-1.50
	control group	.61	
Curriculum Development and Design	experiment group	3.45	4.66
	control group	1.53	

Table V shows the influence of the pre-test scores. The post-test scores show no significant difference between the two groups in teaching assessment and environmental reform and transformation. After the teachers' communication and

professional leadership, the scores reached a significant level. When the influence of the pre-test sores was excluded in the experimental and the control groups, there were significant differences in the performance of the pre-service teachers and professional leaders. In addition, the adjusted averages in Table VI show that the pre-service teachers of the experimental group have significantly better communication skills and professional leadership than the pre-service teachers in the control group.

TABLE V: SUMMARY OF THE CO-VARIATION ANALYSIS OF THE TWO GROUPS OF PRE-SERVICE TEACHERS IN THE EVALUATION OF TEACHING ASSESSMENT, TEACHER-TEACHING, PROFESSIONAL LEADERSHIP, AND ENVIRONMENTAL REFORM

	Source	SS	DF	MS	F	
Teaching Assessment	Covariate	12.10	1	12.10	7.22	**
	Experimental processing	.54	1	.54	.32	
Parent-teacher communication	Covariate	676.71	1	676.71	58.95	***
	Experimental processing	321.13	1	321.13	27.98	***
Professional leadership	Covariate	503.34	1	503.34	42.18	***
	Experimental processing	91.77	1	91.77	7.69	**
Environmental reform transformation	Covariate	152.02	1	152.02	43.86	***
	Experimental processing	1.16	1	1.16	.34	

*P<.05 **P<.01 ***P<.001

TABLE VI: SUMMARY OF THE AVERAGE NUMBER OF PRE-SERVICE TEACHERS IN THE PRE-TEACHER COMMUNICATION, PROFESSIONAL LEADERSHIP UNADJUSTED AND ADJUSTED

		Unadjusted	Adjusted
Parent-teacher communication	experiment group	14.86	14.62
	control group	11.74	11.95
Professional leadership	experiment group	11.80	12.81
	control group	12.06	11.17

Table VII shows the single sample t-test for the satisfaction of the experimental group. The table lists the average and standard deviation of the pre-service teachers after teaching. Table VII shows that the average number of self-adjusted learning strategies exceeds four, and a single sample t-test is achieved, reaching a significant level of .001, thus indicating that the teaching of self-adjusted learning strategies results in satisfaction. The results of the questionnaire indicate that those in the experimental group had a positive attitude to the self-adjusted learning strategy teaching program, and 87.2% of the pre-service teachers expressed satisfaction.

TABLE VII: EXPERIMENTAL GROUP SATISFACTION SINGLE SAMPLE T TEST (N=86)

Unit	M	SD	M > 3 T value
Self-regulated learning strategy teaching	4.07	.55	17.45***

***p<.001

IV. CONCLUSION

Implementing a self-adjusting learning strategy can enhance the cross-disciplinary teaching specialization of pre-service teachers: the experimental teaching and the results of statistical analysis of the research tools show that pre-service teachers who implemented self-adjusted learning strategies were taught in interdisciplinary fields. In terms of specialization, there is a significant improvement in development and design, parent-teacher communication, and professional leadership, with the post-test results of the experimental group being significantly better than those of the control group. This confirms that the experimental teaching was effective; that is, the self-adjusting learning strategy can be implemented, thereby promoting the pre-service teachers' professionalism in cross-disciplinary teaching [24], [25].

Pre-service teachers have a positive attitude to the implementation of self-adjusting learning strategies: in the process of learning self-adjusting strategies pre-service teachers were brave enough to accept the challenges of the new curriculum and the development of Industry 4.0. The self-adjusted learning strategy teaching program has been affirmed and endorsed by most pre-service teachers; they believe that the course can enhance their motivation, self-confidence, and opportunities for communication between teachers and students. It was noted that 87.20% of pre-service teachers expressed their aims and ambitions. The results also showed that pre-service teachers like creative teaching courses [26], [27].

V. IMPLICATIONS

In response to curriculum reform, teachers are playing an increasingly important role in the development of regional industrial characteristics and practical teaching. Therefore it is important to integrate pre-teachers' knowledge of their subject and the development of teaching materials. Teachers' thinking processes, information organization and self-adjustment of teaching plans offer an important reference. Through the process of self-adjustment, the pre-teachers' teaching profession is explored. In addition to understanding the results of self-adjusting teaching strategies, teachers use self-adjusting learning strategies to enhance the interpretation and reflection of curriculum development and develop self-adjustment in response to curriculum reform. Learning strategies depend on teachers' self-reflection, subject professional knowledge and rich teaching experience.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Chou conducted the research; Shen and Shen analyzed the data; Chou and Hsiao wrote the paper; all authors had approved the final version.

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