

Can Student Self-Directed Learning Improve Their Academic Performance? Experimental Evidence from the Instruction of Protocol-Guided Learning in China's Elementary and Middle Schools

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Abstract: *Autonomous learning not only requires students to self-monitor and adjust their cognition, emotions, motivation, behavior, and environment, but also requires the creation of external environments and the provision and support of teaching strategies. Protocol-guided learning is a localized teaching strategy in the mainland of China. This study sampled students from two municipal middle schools in Zhenjiang City, Jiangsu Province as research subjects, and used education experiments to find out the role of students' autonomous learning in improving student performance, and observed how to promote students' autonomous learning through protocol-guided learning as well. A total of 612 students from the first grade of two schools in Zhenjiang City, Jiangsu Province, China were selected as the subjects. After excluding extreme values, a total of 196 experimental samples and 201 control samples were obtained. By analyzing the experimental data of the experimental group and the control group, it is concluded that a well-designed protocol-guided learning teaching can become an effective carrier for students' autonomous learning. By promoting students' autonomous learning, students' performance can be effectively improved. At the same time, we further found that in the three subjects of Chinese, Mathematics, and English, students' autonomous learning has the most obvious effect on Chinese learning.*

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AUTONOMOUS learning refers to the ability of learners to set learning goals, determine learning content and progress, choose learning techniques, monitor self-learning processes, and perform self-assessment (Holec, 1981). In the process of China's curriculum reform, advocating students' autonomous learning has always been an important issue. Due to differences in national and educational conditions, the common autonomous learning modes abroad are not entirely suitable for China. Chinese educators have been striving to explore the autonomous learning model of students with Chinese characteristics, and have also formed some effective teaching modes. But so far, the understanding of these teaching modes is mostly based on experience rather than scientific evidence, which makes it difficult for giving solid evidence on whether local students' autonomous learning modes are really effective or not and tell the underlying reason. Therefore, how to improve the scientific value in the process of exploring students' autonomous learning mode is an essential problem to be solved. Zhenjiang Experimental School has been exploring students' autonomous learning mode based on protocol-guided learning since 2005. After years of exploration, a protocol-guided learning teaching mode with its own characteristics has been formed and achieved remarkable findings. In order to further discuss the effectiveness of this indigenous teaching model, we intended to evaluate the teaching mode by obtaining scientific evidence through a carefully designed experimental study.

Cause of the Experiment

Autonomous learning not only requires students to self-monitor their cognition, emotion, motivation, behavior, and environment, it also requires the creation of external environments and the provision and support of learning conditions and strategies (Li & Qiu, 2017).

Most studies outside of China have pointed out that teaching strategies such as problem-based learning models, class discussions, debates, and case studies can be used to promote autonomous learning. There are many similar studies, which can be roughly divided into three categories: (1) Teaching mode oriented to interpersonal interaction. This model emphasizes the social nature of learning, and believes that increasing the interaction between teachers and students, students and students can reflect the subjective status of students. (2) Teaching mode oriented to learning self-regulation. Facilitate learning by helping students master self-regulating strategies. (3) Teaching mode oriented to meaning construction. This includes pedestal teaching, anchor teaching, example teaching, and inquiry-based autonomous learning. Problem-solving autonomous learning teaching mode is one of the basic reform ideas in the current wave of constructivist reforms. It stimulates students' inner curiosity through the discussion of problems and constructs their own knowledge (Johnson, et al., 2002).

China domestic scholars have also proposed a series of teaching strategies to promote autonomous learning. For example, Cheng and others have put forward the teaching strategy of "autonomous learning centered on the premise of teacher guidance, student collaborative learning as a platform", with the ultimate goal of helping graduate

students to develop autonomously (Cheng, et al., 2014). “Autonomous-mutual assistance learning class”, “Graduate self-learning”, “Problem teaching mode”, etc. proposed by Wu and Wang have made profound contributions to autonomous learning teaching mode (Wu & Wang, 2012). In addition, Pang of East China Normal University in his monograph *Autonomous Learning-Principles and Strategies of Learning and Teaching* comprehensively discussed the psychological mechanism of autonomous learning, the strategy of autonomous learning, and the development of autonomous learning capabilities. He put forward the idea that cooperative learning is collective autonomous learning, thinking that research on autonomous learning can be carried out through theoretical, experimental, quiz, observation, and action research methods (Pang, 2003).

In the process of exploring the teaching mode that is more suitable for students' autonomous learning, many Chinese schools and teachers have adopted protocol-guided learning as an important means to achieve curriculum reform. At present, based on different perspectives, the definitions of protocol-guided learning are not completely consistent. But generally speaking, it is believed that protocol-guided learning is a protocol prepared by teachers to guide students to autonomous learning, and protocol-guided learning means that teachers use protocol-guided learning as the basis, and use protocol-guided learning to guide students prior to, during, and after the class, so as to constructing knowledge and skills to complete teaching tasks (Dong & Liu, 2017).

Protocol-guided learning has become the main way to implement autonomous learning reform in schools. However, in the implementation process, although most schools declared that the implementation of protocol-guided learning was “in order to change the way students learn”, so that students “learned to learn” and embarked on the road of autonomous learning. However, due to limitations of inherent teaching ideas, teacher allocation, and resource precautions, many schools often use protocol-guided learning as a student's “task list” and “exercise list.” In the teaching process, although there is a form of “learning”, the entire teaching process is still teacher-led. If the teaching is not really implemented from the student's “learning”, it will not produce a substantial change in “student autonomous learning” (Han, 2012; Wu, 2011).

In response to this problem, in the long-term protocol-guided learning teaching reform process, Zhenjiang Experimental School has always inspired students' autonomy and achieved autonomous learning as the goal of this reform. After many years of exploration, a set of distinctive and effective protocol-guided learning teaching programs has been formed. The outstanding feature of this program is the emphasis on autonomous learning of students. Whether it is the teacher's preparation, teaching or after-school tutoring, it must be based on students, take students as the main body, adopt the teacher-student joint construction knowledge, and carry out teaching in the basic form of student cooperation inquiry and teacher teaching. In the teaching process, teachers are different from the traditional role of “inculcator”. They play the role of “problem motivator” and “exploration helper”. They organize students' autonomous learning and teamwork to complete teaching tasks. Only when students face general problems or problems that their own abilities are difficult to solve, will teachers help students complete knowledge learning tasks as “knowledge givers”. So far, Zhenjiang Experimental

School has also formed a complete set of teaching system of protocol-guided learning and has achieved significant findings (Xia, 2017).

So far, although academic circles have discussed the students' autonomous learning and protocol-guided learning teaching, most of the existing researches are academic studies, and related empirical studies are still lacking. In these few empirical studies, Peng et al. studied the situation of autonomous learning in the context of the new curriculum and concluded that even in high school, the attitude, behavior, and environment of students' autonomous learning are still not satisfactory (Peng & Xiang, 2015). This shows that there is still a lot of room for improvement in students' autonomous learning. In addition, some studies summarize the results and experience of front-line protocol-guided learning teaching experiments (Zhang, 2000; Han, 2000). Although this type of research reports research results in the name of "experiment", the research process does not meet the requirements of rigorous experimental research. Most of them are action research, and the robustness of the results needs to be further improved.

The abovementioned analysis has shown that protocol-guided learning does not necessarily help students' autonomous learning. How to compile and implement protocol-guided learning teaching is the key to whether protocol-guided learning teaching can achieve its goals. Even though some schools currently improve student performance through "protocol-guided learning", on the one hand, such studies often do not strictly control the interference variables, so it is difficult to distinguish what factors have improved student performance. On the other hand, as mentioned earlier, although some studies claim to be "protocol-guided learning", but they actually implement "exercise-list teaching" and "task-list teaching." In this case, the improvement of student performance has nothing to do with students' autonomous learning (Jiang, 2005).

To clarify these issues, stronger evidence is needed to support them. However, existing studies do not provide sufficient evidence to help people understand whether protocol-guided learning can improve student performance and what kind of protocol-guided learning teaching can really promote autonomous learning for students. In view of this, this research Zhenjiang Experimental School's protocol-guided learning teaching reform is used as the main intervention variable, and an experimental study is used to discuss the following questions: First, how should students' autonomous learning be promoted through protocol-guided learning? Second, can students' autonomous learning really promote students' performance improvement?

Research Design

Objective

As mentioned earlier, the current use of protocol-guided learning for teaching is a common phenomenon in Chinese elementary and middle schools and is considered to be an effective means to achieve autonomous learning for students. However, because protocol-guided learning prepared by different schools is different, not all protocol-

guided learning can effectively promote students' autonomous learning. In the process of protocol-guided learning, many schools still adopt teacher-led teaching methods, and study plans have become a carrier and means to achieve teachers' unilateral goals. We believe that to achieve effective learning, we must first start with student autonomy. Teaching students realizing autonomous learning is a more important teaching goal than simply teaching students getting knowledge and test-taking skills. To achieve this goal, in the process of designing and implementing protocol-guided learning, we need to adhere to the student-centered teaching philosophy, and incorporate more students' independent inquiry and cooperative learning links and elements through protocol-guided learning to stimulate students' enthusiasm for learning and then get better outcomes.

Based on this understanding, the objective of our experiment is to verify whether student-centered protocol-guided learning teaching can effectively promote student's autonomous learning and improve student performance. In this process, we explore the realization of an efficient protocol-guided learning teaching mode suitable for China's national conditions.

Participant Selection

We selected 6th graders from two middle schools in Zhenjiang, Jiangsu, China as the test subjects. Among them, Zhenjiang Experimental School was used as the experimental group. Due to the large scale of the Zhenjiang Experimental School, which far exceeds that of the control group, only 271 students from classes 1-6 in the 6th grade were selected to participate in the experiment. In the experimental group, the student-centered protocol-guided learning developed by Zhenjiang Experimental School is used for teaching. The control group is another middle school in Zhenjiang. This middle school has a total of 341 students in 8 classes. Although protocol-guided learning is also implemented, during the implementation process, the teaching requirements of the student center are not particularly emphasized. The characteristics of teacher-led teaching are obvious.

In order to better control the influence of students' pre-assignment conditions and pre-test differences on experimental results, we first exclude extreme values according to the student's family background. After obtaining the pretest results, we matched the data in the experimental group with the data in the control group, and matched the reference samples based on the total scores of the students in Chinese, Mathematics, and English. After deleting the samples that were absent, we finally got 196 samples in the experimental group and 201 samples in the control group.

The two schools participating in the experiment were both public schools with good local school strength and reputation. There are no significant differences between the two schools in terms of teachers, student resources, and school conditions.

Experimental Interventions

Student-centered protocol-guided learning is the main intervention in this study. In the teaching reform process, Zhenjiang Experimental School has consistently held the view

that in order to achieve the improvement of students' academic performance; the "learning behavior" must first take place, Even if students really consider learning to be their own thing and not something they have to do that is based on external pressure. To achieve this, the simple implementation of protocol-guided learning is difficult to achieve, but only by using protocol-guided learning as the carrier of student's autonomous learning can improve the academic performance while teaching students how to learn. Zhenjiang Experimental School adheres to this concept, and in the course of more than two decades of teaching reform, it has continuously explored and formed a protocol-guided learning teaching with its own characteristics. Compared with the protocol-guided learning teaching in the control group school, the experimental group's protocol-guided learning emphasizes student autonomous learning in concept. Teachers switched the emphasis of teaching from knowledge infusion to student-oriented guidance and assist. In terms of content and implementation, more autonomous and cooperative learning links are included to give full play to students' own learning initiative. In the use of school plans, they are generally not used as task lists and worksheets, but rather as a process for teachers and students to jointly build knowledge and balance the interaction between teachers' teaching and students' learning.

Experiment Procedure

This experiment was planned by the end of August 2019, officially started in November 2019, and ended in mid-January 2020. Both schools use school-based protocol-guided learning for teaching. The difference is that Experimental School's protocol-guided learning pays more attention to students' autonomous learning. The 6th-grade Chinese, Mathematics and English subjects of the two schools participated in the experiment, and the students' learning progress and content were the same.

From September 2019 to the end of October 2019, the preparation stage for the experiment. At this stage, the two universities first identified the students and teachers participating in the test, and through matching and comparison, ensured that the conditions of the teachers and students were basically the same, and there was no significant difference. Secondly, coordinated the teaching content and progress, and train the experimental and control group teachers separately to ensure that the protocol-guided learning teaching mode of the two schools meets the experimental requirements. Further, prepared the materials needed for the experiment and determined the specific process for the experiment.

From early November 2019 to mid-January 2020, the experimental implementation phase lasted ten weeks. At this stage, the two schools were teaching according to their own protocol-guided learning. Before and after the experiment, pre-test and post-test were conducted on the students participating in the experiment. The test were a unified standardized questions prepared by the *Teaching and Research Office of Zhenjiang City*. In the experimental group and the control group, student performance was used as an indicator of teaching effectiveness. The experimental group and the control group both used protocol-guided learning for teaching, but the difference was that the experi-

mental group mainly improved students' performance by cultivating autonomous learning skills: that is, students actively discover problems through pre-class previews, so that students could bring problems into the classroom. Let classroom teaching become a learning process of independent inquiry and problem solving; group display and achievement sharing in the classroom allow students to fully demonstrate themselves; self-evaluation and mutual evaluation of students after class allowed students to improve themselves in evaluation. The control group's protocol-guided learning emphasized teacher-centeredness and the protocol-guided learning was the carrier of teachers' teaching plans and student homework training. Through the experiments, we tried to clarify whether the students' autonomy can effectively improve student performance.

Experimental Results and Discussion

Class Observation Results

In the course of the experiment, we observed the class situation of the participating classes in the two schools through listening and inter-school communication, and found that there was a significant difference between the two types of protocol-guided learning teaching.

In the experimental group of Zhenjiang Experimental School, since protocol-guided learning itself is the guidance of students' autonomous learning, there are clear requirements for students' autonomous inquiry activities in the teaching process. Therefore, its teaching process has actually become a process of reconstructing the teacher-student relationship. More often, students complete the learning tasks jointly formulated by teachers and students through active inquiry, active thinking and mutual cooperation. The proportion of students' classroom participation and interactive activities is significantly higher than that of the control group. But we also observe that because such classrooms are often not implemented exactly as planned. Therefore, there are many uncertainties in the teaching implementation process. Compared with the traditional teaching mode, this teaching mode places higher requirements on the ability of teachers to coordinate and organize. In some teaching links, classroom order and teaching logic can be optimized further.

In the control school, we have observed that although protocol-guided learning was also used in teaching, the design and implementation of protocol-guided learning was basically based on the teaching mode of teacher-led and textbook-based learning. In the teaching process, although there was teacher-student interaction, the main way was to achieve the form of question and answer; the intensity of group cooperation activities of students was significantly lower than the experimental group; in many cases, the guided protocol was not the student's "activity list" but rather Students' "task list" and "work list". Compared with the experimental group, the teaching in the control group was more rigorous and orderly, and the teaching plan was more complete.

Experimental Effect Size

Based on the performance data before and after the test, we calculated the effect size of the experiment. The calculation results in **Table 1** show that, overall, the effect size of the student's total score is 0.117. According to the research of Chueng and Slavin (2012), under the same conditions, it is often difficult to obtain a large effect amount in the study of large samples (sample size greater than 250). Considering the large sample size of this study, although such an effect size is not very large, it shows that the experiment has achieved results. In terms of the results of various subjects, the experimental effect of Chinese language is the best, and an effect amount of 0.259 is obtained. After further observation of the pre-test results, we found that the language score of the experimental group was slightly lower than that of the control group at the time of the pre-test, but the average score of the experimental group had exceeded that of the control group at the time of post-test. This is obviously a very satisfactory result. The effect amounts of Mathematics and English are 0.091 and 0.071 respectively. Although not large, it also shows that the students in the experimental group have made greater progress in these two subjects than the students in the control group.

Discussion of Results

So far, few China domestic studies have given strong evidence on whether students' autonomous learning can improve their performance. Domestically, many studies have linked students' autonomous learning with quality education and advocated it as the opposite of "examination-oriented education" (Wu, 2011; Dong & Liu, 2017). But as Zimmenma (1986), the representative of autonomous learning theory, believed that autonomous learning can improve the efficiency of learning by improving students' self-efficacy. This means that there is no contradiction between students' autonomous learning and performance improvement. The conclusion of this study proves that well-designed protocol-guided learning has a positive effect on improving students' academic performance while promoting students' autonomous learning.

In this experiment, the experimental school adopted a more student-centered protocol-guided learning teaching mode, and the final research results show that the former is more conducive to the improvement of student performance than the teacher-centered protocol-guided learning teaching. In terms of various subjects, it seems that this teaching mode has a more significant effect on the language subject. This may be due to the more emphasis on logical thinking and the emphasis on memory compared to mathematics. Good communication and positive perceptions are more conducive to improving Chinese performance. As students have autonomous learning, because there is more communication between teachers and students and between students, it is obviously more conducive to students' understanding and grasp of the content of Chinese learning.

Compared to teacher-centered teaching that places more emphasis on knowledge transfer, students' autonomous learning pays more attention to cultivating students' inquiry abilities and thinking styles. In the experiments, the experimental group's protocol-guided learning teaching has always focused on the students' learning

Table 1. Experimental Effect Size.

Subject	Pre-Test				Post-Test				Effect Size
	Control (N=201)		Experiment (N=196)		Control (N=201)		Experiment (N=196)		
	Mean Score	SEM	Mean Score	SEM	Mean Score	SEM	Mean Score	SEM	
Chinese	89.096	6.386	87.435	6.602	92.715	7.788	92.736	7.993	0.259
Math	94.964	14.701	95.769	13.505	88.296	15.458	90.562	15.161	0.091
English	94.343	13.380	96.644	13.933	93.834	14.636	97.218	13.656	0.071
Total	278.379	29.627	279.828	30.153	273.485	37.924	279.555	35.246	0.117
SEM: Standard Error of Means.									

activities. The teaching activities are centered on the students' problem-solving problems, displaying learning results, summing up learning experiences, strengthening learning results, and expanding the content of extended learning (Xia, 2017). In this teaching mode, fundamental changes have taken place in classroom teaching, from the original one-way, receptive learning to a two-way active learning that combines student cooperation, inquiry, display training, teacher guidance, and guidance, where students truly become the master of learning, learning really happens to students (Lu, 2016). Therefore, we expect that the longer the training for autonomous learning, the longer the impact on student performance. However, due to the limitations of this experiment, we did not further investigate the long-term effects of autonomous learning, which needs to be further strengthened in future research.

Conclusion and Suggestion

This research proves that well-designed protocol-guided learning teaching can be an effective carrier for students' autonomous learning. By promoting students' autonomous learning, students' performance can be effectively improved. Among the scores of each subject, students' autonomous learning has the most significant effect on the effect of Chinese learning.

Based on this, we believe that, on the one hand, schools and teachers need to further improve teaching concepts and attach importance to autonomous learning of students. Most Chinese teachers are accustomed to the teaching mode of the teacher center, which has both the influence of teaching habits formed for a long time, and the reasons for fear of changing the teaching mode. This study proves that there is no inevitable contradiction between autonomous learning and improving students' performance. To achieve the teaching mode change, teachers need to be brave enough to change teaching perspectives and boldly return the learning autonomy to students. On the other hand, careful design of protocol-guided learning is needed to make it truly a carrier of autonomous learning for students. As mentioned earlier, many schools only use study

cases as “task sheets” and “worksheets” when teaching protocol-guided learning. This study proves that if protocol-guided learning is to truly promote students’ autonomous learning, it is necessary to carefully design protocol-guided learning, increase the proportion of teacher-student interaction, student inquiry and cooperative learning in the teaching process, and make protocol-guided learning it has truly become a bridge between teaching and learning, providing effective guidance and assistance for students’ autonomous learning.

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