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An Empirical Study on the Data Analytics-based Self-Regulated Learning Scaffolding Model for Primary Students

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Abstract: *In the age of Internet Plus, the deep integration of information technology into education and individualized instruction have become a growing trend in education development. Self-regulated learning is a key element of student core competence, but easy to be overlooked in basic education. The purpose of this study is to establish the data analytics-based self-regulated learning scaffolding model for primary students and test its results in teaching practice, citing Scaffolding Theory and Zone of Proximal Development Theory as its rationale. Research findings demonstrate that learning data analytics-enabled self-regulated after-class learning can help enhance learning outcomes and develop student learning strategies.*

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Introduction

The integration of big data and artificial intelligence into education and teaching is a driving force for more scientific and goal-oriented development of learning, teaching, and administration. Huge amounts of data have been amassed through expanded application of online learning platforms. Learning data mining, analytics, and modeling allow teachers to precisely grasp student learning situation and to improve instructional efficiency and effectiveness; education administrators can equalize the distribution of educational resources. It has been acknowledged in relevant investigations that self-regulated learning ability is a key component of student core competence and a foundation for further education; and that educational technology can serve as scaffolding that supports student after-class learning. How to deploy educational technology as a measure supporting primary students' after-class learning? To address this question, we attempted to construct a data analytics-based self-regulated learning scaffolding model for primary students and verified its effects on student learning outcomes through experiments.

Research Methodology

This study selected two classes taught by the same teacher in X Primary School in Ningxia Province to conduct a control experiment. One of the classes was randomly chosen as the experimental group and required to use the scaffolding model to carry out self-regulated after-class learning; Learning data were also collected from the control group, but no intervention was imposed on it. The learning analytics system developed by the project team was used as a supporting platform, and an intelligent teaching environment was built in X School to track and evaluate student learning activities in and after class. Researchers used the questionnaire survey to identify the change in student learning attitudes and strategies. The results of the diagnosis and assessment of student cognition were used to compare the learning efficacy of the experimental group and the control group. The measurement tool was designed by three senior mathematics teachers and the pre- and post-tests were conducted at the beginning and end of the experiment respectively.

Research Findings

The Effect of the Scaffolding Model on Learning Outcomes in Student Self-Regulated Study

Comparing the results of the diagnosis and assessment of student cognition before and after the experiment, we discovered that there was a significant gap in the scores between the two groups after the experiment. The average post-test score of the experimental group was 12.5 points (against a total score of 100 points) higher than that of the control group, and the difference reached a significant level ($t = 3.558$, $p < 0.05$). Looking at the score change among students with different pretest results, we found that

scores of medium- and lower-level students increased, whereas those of high-achieving students declined.

The Effect of Scaffolded Self-Regulated Learning on Student Learning Strategies

The learning strategies of students in the experimental group significantly changed after the experiment. Specifically, student cognitive strategies and resource management strategies improved remarkably; the average score of metacognitive strategies rose slightly, but the increase did not reach a significant level.

In addition, this study also ascertained a positive correlation between test score improvement and the level of learning strategies ($r = 0.204$, $p < 0.05$). In other words, students with higher levels of learning strategies could achieve better learning results in scaffolding-based self-regulated study.

The Impact of Student Learning Attitudes and Self-regulated Learning Process on the Outcomes of Scaffolding-Supported Study

The questionnaire was designed to survey student learning attitude improvement in three dimensions: emotion, cognition, and behavior. According to the pretest results, the average score of student learning behavior was relatively low, while those of student learning emotions and cognition were slightly higher. The results of the matched samples t-test indicated that student learning attitudes did not improve significantly after the experiment; and that there were considerable gaps in pretest results among students of low, medium, and high levels of learning attitudes [$F(2, 47) = 3.282$, $p = 0.046$], while the gaps were significantly closed in the posttest [$F(2, 47) = 0.774$, $p = 0.467$], probably due to the fact that in the highly structured scaffolding-based self-regulated learning, student behavior and learning paths are less likely affected by objective attitudes.

Discussions and Conclusions

Scaffolded Self-Regulated Study Based on Data Analytics can Improve Student Learning Results

Examining student performance before and after the experiment, we discovered that the scaffolding model can effectively promote student cognitive development. In self-regulated after-class learning, the proper use of learning analytics system to obtain feedback on learning results and impose timely intervention in the learning process can significantly improve student learning efficiency and boost student cognitive development. Appropriate learning material organization has a positive effect on the outcomes of self-regulated learning, and students should follow the sequence of learning-practice in the self-regulated after-class study.

Scaffolded Self-Regulated Study has a Positive Influence on Student Learning Strategies.

Scaffolded self-regulated study can upgrade student learning strategies because the dashboard of the scaffolding can visualize learning analytics results and present them to students in time. When students are regularly updated on their learning progress and provided with corresponding improvement suggestions, their learning motivation, confidence, and efficacy will be enhanced, which help students clarify their learning goals and modify their learning process.

Individual Characteristics of Students and Learning Paths can affect the Outcomes of Scaffolded Self-Regulated Learning.

The outcomes of scaffolded self-regulated learning vary among students of different original academic levels. This learning model is more effective to students of medium and low academic levels, while high achieving students can adjust their learning strategies by themselves.

In addition, scaffolded self-regulated learning can mitigate the negative impact of learning attitudes on student learning results. In the dashboard-based individualized learning, learning attitudes have no significant influence on learning results, because the system formulates personalized learning paths for students and provides corresponding learning resources, and the scaffolding model helps standardize the processes of self-regulated learning for students.

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