

# Which Teaching Modalities Are More Effective in Promoting Deep Learning among Junior Secondary School Students

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**Abstract:** Deep learning is a learning approach that is highly advocated in China's basic education curriculum reform. Based on a survey of 1,277 junior secondary school students from 12 schools in S City, Jiangsu Province, China, this study seeks to explore the effects of teaching modalities on deep learning of students at the junior secondary level. Analysis methods include OLS regression and random forest. The study's results reveal that inquiry-based teaching has the most significant positive effect on student deep learning, though with gender differences; that differentiated instruction is the most frequently used teaching modality and positively affects student deep learning; that didactic teaching makes the smallest difference to student higher-order learning and integrative learning; and that cooperation-focused teaching positively affects student integrative learning, but its impact on student reflective learning is minimal.

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## Introduction

**D**EEP LEARNING is regarded as a meaningful learning process, in which students, under the guidance of teachers, actively engage in challenging learning tasks, experiencing success and development. It necessitates a shift from the focus on literal comprehension and rote memorization to an emphasis on deep understanding, problem-solving, and creativity cultivation.

Students at the junior secondary level are undergoing the most significant physical and psychological changes in their lives while also being in a critical stage of knowledge and competence development. The capabilities of their minds are in rapid growth, resulting in significant improvements in learning capacities, thinking skills, expression abilities, motor functions, and self-concept. Cultivating deep learning competence is of vital importance for their holistic development and their adaptation to future societal changes. Unquestionably, teachers' classroom behavior has a profound impact on the growth of this student group. Research suggests that the teaching modality implemented by the instructor can largely decide whether their students adopt deep or surface approach to learning.

This study focuses on three research questions: (i) Can the teacher promote deep learning in junior secondary school students by their choice of teaching modalities? (ii) Which teaching modality has the greatest effect on deep learning of these students? (iii) Is there heterogeneity in the effects of teaching modalities on their deep learning? The multiple linear regression and random forest were employed to analyze large-scale survey data from junior secondary school students.

## Research Hypotheses

In this study, teaching modalities refer to instructional strategies and approaches employed by teachers to achieve specific educational objectives. Based on existing research, the study posits didactic teaching, inquiry-based teaching, cooperation-focused teaching, and differentiated instruction as representative teaching modalities in current junior secondary education. Drawing on the tripartite structure of deep learning theory, the study decomposes student deep learning into three dimensions: higher-order learning, integrative learning, and reflective learning. Research hypotheses include:

H1: Didactic teaching has a significant and negative effect on deep learning of junior secondary school students.

H2: Inquiry-based teaching has a significant and positive effect on deep learning of junior secondary school students.

H3: Cooperation-based teaching has a significant and negative effect on deep learning of junior secondary school students.

H4: Differentiated instruction has a significant and positive effect on deep learning of junior secondary school students.

H5: There are gender differences in the effects of teaching modalities on deep learning of junior secondary school students.

H6: There are grade differences in the effects of teaching modalities on deep learning of junior secondary school students.

## Research Design

The study uses self-report data to examine the relationships between teaching modalities and student deep learning. The teaching modality is the independent variable, measured by the Questionnaire on Junior Secondary School Students' Perception of Teaching Modalities, which encompasses 17 items. Student deep learning is the dependent variable, measured by the Junior Secondary School Student Deep Learning Questionnaire, which comprises 13 items. Both questionnaires adopt a 5-point Likert scale, where 1 represents "totally disagree" and 5 "totally agree." Control variables include gender, grade, being the only child or not, holding a leadership role in class or not, self-expectation of education, and parental tutoring, and school fixed effects are incorporated in the regression estimation.

The questionnaires underwent four rounds of drafting and revision before being administered in the survey. Cluster stratified sampling was adopted for the formal survey. The sampling process consists of two steps: first, two schools were drawn from each district of S City with a total of 12 secondary schools participating; second, one class each in the seventh and eighth grades was drawn from every school sampled, and electronic questionnaires were distributed to the student participants. Together, 1,780 questionnaires were collected, ultimately yielding 1,277 valid responses.

Additionally, confirmatory factor analysis was performed on the finalized questionnaires to ensure a good fit between the collected data and the theoretical model. Furthermore, all dimensions of both models demonstrated good convergent validity, showing that each dimension has sufficient discriminant validity from the others. Also, the Cronbach's  $\alpha$  coefficients for each dimension indicated desirable reliability of the two measurement instruments.

For data analysis, the study employs ordinary least squares (OLS) to construct a baseline model of the relationship between the teaching modality and deep learning of junior secondary school students, using the former as the independent variable and the individual dimensions of the latter as the dependent variables. Based on the OLS regression, the study uses the out-of-bag (OOB) error rate to measure variable importance.

## Research Findings

Inquiry-based teaching had the greatest positive effect on deep learning of junior high school students, but with gender differences. The ranking of variable importance shows that inquiry-based teaching had the most significant impact on all dimensions of student deep learning; meanwhile, the results of the heterogeneity test reveal that this teaching modality was more effective in promoting higher-order learning and integrative learning among male students.

Differentiated instruction was the most frequently used teaching modality with a positive effect on student deep learning. Descriptive statistics show that differentiated instruction was used most frequently among the four teaching modalities. Furthermore, OLS regression analysis indicates that this teaching modality had a significant and positive effect on all dimensions of student deep learning.

Combining the results of OLS regression and random forest, it is found that didactic teaching had a significant and positive effect on student higher-order learning and integrative learning. Nevertheless, the ranking of variable importance indicates that this teaching modality made the smallest contributions to these two dimensions of student deep learning among the four instructional modalities.

Cooperation-focused teaching had a positive effect on integrative learning but with minimal impact on reflective learning. According to the OLS regression results, cooperation-focused teaching had a significant and positive effect on integrative learning, while the ranking of variable importance shows that this teaching approach posed the slightest impact on student reflective learning among all four teaching modalities.

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