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Effects of Youth Mentoring Programs

By Rhodes, E. B., Stams, J., Card. G. J. J. M., et al.

MENTORING programs that pair young people with non-parental adults are a popular strategy for early intervention with at-risk youth. To examine the extent to which these types of interventions improve outcomes for young people, Elizabeth B. Raposa and colleagues conducted a meta-analysis of outcome studies of one-to-one youth mentoring programs written in English between 1975 and 2017.

Their analysis included 70 studies with a sample size of 25,286 children and young people (average age = 12 years), and considered five broad outcome categories: school, social, health, cognitive, and psychological outcomes.

The findings from their meta-analysis suggested:

- There was no significant difference in effect sizes across these five types of outcomes.
- Overall, they found an average effect size of +0.21 across all studies and outcomes, which is consistent with past meta-analyses that have shown overall effect sizes ranging from +0.18 to +0.21.
- Programs that had a larger proportion of young males who were being mentored in the sample, a greater percentage of male mentors, or mentors who worked within the helping profession showed larger effect sizes, as did evaluations that relied on questionnaires and youth self-report.

The authors suggested that the findings provided some support to the efficacy of one-to-one, caring relationships with adults, and low-cost mentoring programs.

Source： Journal of Youth and Adolescence 2019; 48(3): 423–443.

Is Social-Emotional Learning Linked to Academic Performance?

By Panayiotou, M., Humphrey, N., & Wigelsworth, M.

A STUDY published in *Contemporary Educational Psychology* looks at the benefits of a school-based social and emotional learning (SEL) intervention in relation to academic achievement by examining how the four main components that underlie the SEL model (children's social-emotional competence, school connectedness, mental health problems, and academic achievement) interact over time.

Margarita Panayiotou and colleagues from Manchester Institute of Education used data drawn from a major cluster randomized trial of the Promoting Alternative Thinking Strategies (PATHS) curriculum to present a three-wave (annual assessment, T1, T2, and T3) longitudinal sample. The sample included 1,626 students from 45 primary schools in north-west England. They examined the relationship over time between social-emotional competence (T1), school connectedness (T2), mental health difficulties (T2), and academic achievement (T3), and whether exposure to an SEL intervention (in this case, PATHS versus usual provision) had any effect on these relationships. Findings were as follows:

- Social-emotional competence at T1 had a positive influence on school connectedness and mental health difficulties at T2.
- However, SEL was only a significant predictor and mediator of academic achievement at T3 after controlling for gender and prior academic performance.
- Students who had greater social-emotional competence at T1 were reported to experience fewer mental health difficulties at T2, and this in turn predicted higher academic achievement at T3 ($p<0.01$).
- However, greater connectedness to school at T2 did not predict later academic achievement.

Intervention exposure did not appear to influence these relationships.

Source： Contemporary Educational Psychology 2019; 56: 193–204.

The Effect of a World Cup on Students' Effort and Achievement

By Metcalfe, R., Burgess, S., & Proud, S.

A STUDY published in the *Journal of Public Economics* examines how leisure time can impact students' effort and educational achievement by looking at the overlap of major soccer tournaments (the FIFA World Cup and the UEFA European Championship) with GCSE exams in England (GCSEs are high-stakes exams taken in the UK).

Using seven years of subject data on students in England, taken from the National Pupil Database, Robert Metcalfe and colleagues estimated the overall effect of a tournament by comparing within-student variation in performance during the exam period between tournament and non-tournament years.

- Overall, they found a negative average effect of the tournament on exam performance, as measured by whether students achieved a grade C or higher in at least 5 subjects at GCSE.
- In tournament years, the odds of achieving the benchmark of a grade C or higher in at least 5 subjects fell by 12%.
- For students who are likely to be very interested in soccer (defined as likely to be white, male, disadvantaged students), the impact is greater, with the odds of achieving the benchmark reduced by 28%.

This result is important, as this group is already the lowest performing, with only 21.3% achieving a grade C or higher in at least 5 subjects at GCSE in non-tournament years. The result is also consistent with previous studies which found that some students perform less well in their GCSEs in years when there is a major international soccer tournament taking place.

Source： Journal of Public Economics 2019; 172: 111–126.

Are Immigrant Children More Likely to Pursue STEM Careers?

By Rangel, M. A., Shi, Y.

FINDINGS from a new study published in the *Proceedings of the National Academy of Sciences* suggest that immigrant children study more math and science in high school and college, which means they are more likely to pursue STEM careers.

Marcus Rangel and Ying Shi looked at the trajectories of more than 286,000 children born outside of the U.S., and who moved to the U.S. before age 16, using nationally representative datasets including the 2010-2016 waves of the American Community Survey, the National Longitudinal Study of Adolescent Health, and the National Survey of College Graduates.

They found that:

- Among U.S.-born children, about 20% of college students major in STEM subjects (science, technology, engineering, and mathematics).
- However, among those born outside the US - particularly those who moved to the U.S. after age 10, and don't come from English-speaking or northern-European countries where the native language is linguistically close to English - this number is much higher, with around 36% majoring in STEM subjects.
- Children arriving after age 10 earn approximately 20% more credits in math-intensive courses than they do in English-intensive courses. This focus then continues throughout college, which in turn leads to pursuing a career in a STEM field.

The authors suggest that older children who immigrate to the U.S. from a country where the native language is very dissimilar to English may choose subjects that rely less on language skills and build more on skills they are relatively more comfortable with, such as math or science.

Source：Proceedings of the National Academy of Sciences 2019; 116(2): 484–489.

Does a Parent's Anxiety about Math Negatively Affect Their Child's Math Achievement?

By Schaeffer, M. W., Rozek, C. S., Berkowitz, T., Levine, S. C., & Beilock, S. L.

A MATH app intervention may help eliminate the negative association between parents' math anxiety and children's math achievement in early elementary school, according to a study published in the *Journal of Experimental Psychology*.

The researchers tracked the math achievement of 587 students from 40 classrooms in the Chicago area from first to third grade. In the first grade, students and their families were randomly assigned tablets loaded with either a math app or a similar reading app.

Parents were also given a questionnaire to complete in order to assess a variety of attitudes and behaviors related to math and reading. Math anxiety was measured using the Mathematical Anxiety Rating Scale. At the end of the first grade, they were given a second survey to complete. Children's math achievement was measured using the applied problems subset of a nationally-standardized test. The findings showed:

- By the end of third grade, children of math-anxious parents who were in the reading app control group had learned less math than children of parents with no math anxiety, learning the equivalent of approximately five fewer months of math.
- However, this was not the case for children in the math app intervention group, and children with math-anxious parents showed the same math progress as students with parents who had no math anxiety.

These results suggest that parents' math anxiety is negatively associated with children's math achievement in early elementary school, and that the decreased negative association observed in the intervention group is due in part to a change in parents' attitudes. The researchers conclude that when families used the app together, parents' attitudes toward math changed and they were able to disassociate their own math anxiety from their children's ability in math.

Source： Journal of Experimental Psychology: General 2018; 147 (12): 1782-1790.

ORIGINAL ARTICLE

Experimental Study on the Construction and Hierarchical Teaching of "Pizza Type" Study Group in English in Elementary School

Xuefeng Niu

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Abstract: We take the problem of the intensification of English learning polarization in the senior students in the elementary school, and carry out the "Pizza-type" study group construction for the inefficient teaching phenomenon of grouping and despise cooperation in group learning. It was found that with the revelation: in practice, summed up the "Pizza learning group" construction method, summed up the "hierarchical" learning and teaching strategies, formation evaluation mechanism "Individual Three-Level, Cooperation in Three Dimensions", and effectively alleviated the phenomenon of increased polarization.

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***Keywords**: "Pizza-type" English study group; Hierarchical teaching; Teaching experiment*

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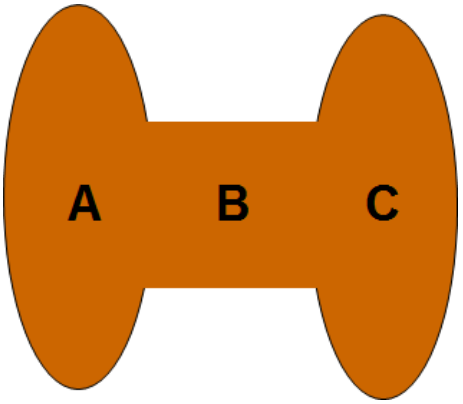
***Conflict of Interests**: None.*

Thinking: Performance Differentiated, Urgent Prescription Needed

THE senior students in our school have a more serious phenomenon of English learning polarization, and the ratio of excellent to medium to weak is "Barbell-Shape". This is also a common phenomenon in most regional schools. Group cooperative learning is the most frequently used form of learning in the English language curriculum. But Through classroom observation, we found that the cooperative learning group is not uniform in strength, students' classroom participation is uneven, and many students have become classroom "bystanders", "pseudo-cooperation" and "pseudo-learning" phenomenon (Wang, 2004). Based on this situation, we have carried out research on the formation and learning evaluation of cooperative learning groups.



Barbell-Shaped English Grading.
A: Outstanding students
B: Middle-level students
C: Weak students

Action: Building a Pizza Study Group, Implementing a Hierarchical Learning Strategy, and Exploring a Multidimensional Evaluation Mechanism

Building a "Pizza-Type" Study Group to Achieve Mutual Development

The Interpretation of the Pizza Type "Learning Group"

Figure 1 displays a pizza cake that can be cut into individual pieces of different sizes as needed. It can be flexibly selected, split or combined according to individual needs.

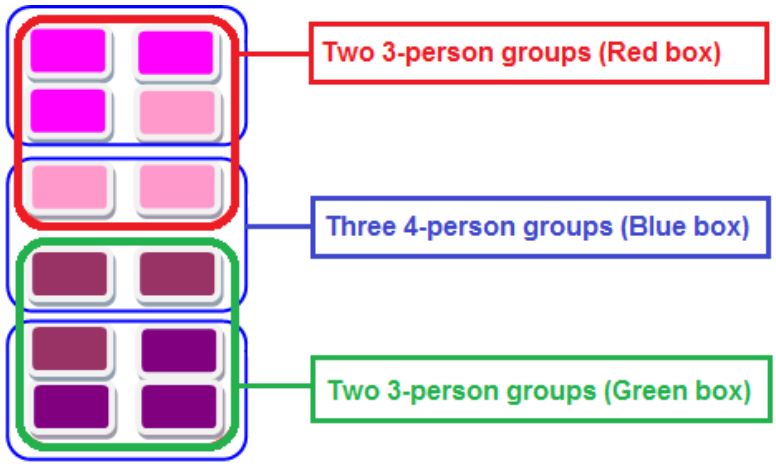
In practice, I tried the construction of the "Pizza-type" study group under the traditional 12- person study group (**Figure 2**).

Grouping Strategy for the "Pizza-Type" Study Group

Balance

Figure 1. A Pizza Cake.

Figure 2. Schematic Diagram of the "Pizza Type" Study Group.



The traditional 12-person study group is divided into two 6-person study groups. The 6-person group is divided into two 3-person study groups, as shown in the pink and purple blocks. The entire group consists of: four 3-person study groups, three 4-person study groups, two 6-person study groups, and 6 pairs of study companions. This grouping can meet the flexible tasks and role division of the Elementary School English classroom.

Balance of strength. According to the learning ability, the whole class will be divided into three levels of equal ABC, A for outstanding students, B for middle-level students, and C for weak students. Each three-person study group is paired with three ABC students.

Balance between men and women. In the three- person study group, in addition to the balance of strength, care for boys and girls to meet the role-playing needs, while allowing students to learn heterosexual cooperation and complementary learning.

Stability

Fixed member. The fixed nature of the group members makes it easy to carry out long-term and stable group cooperative learning binding evaluation, and cultivate students' sense of belonging, collective honor, cooperation and responsibility.
Fixed seat. The group has fixed seats, which is convenient for teachers to conduct stratified teaching during the teaching process, reduce the blind spot area in the classroom teaching, and facilitate the stable and convenient mutual learning in the group.

Incentive

The top level is aroused to stimulate potential. A-level students are responsible for counseling the two levels of students, B and C, and answering questions in a timely manner. In the help, they will raise their self-requirement and realize conscious and efficient learning.
Mezzanine promotes learning and promotes improvement. B-level seeks help from A-level students, and then passes the learning to C-level ones and corrects them. In the process of actively absorbing and transferring, he changes his own learning state.
The bottom layer is tempted to learn. C-level students are responsible for group activity reporting, and urges them to actively participate in various learning activities with a sense of team belonging and honor, and change the status of past "bystanders" in the classroom.

Organizational Construction of the "Pizza-type" Study Group

The pizza-type 6- person study group seating arrangement is as follows (**Figure 3**).

Implement a "Hierarchical" Learning and Learning Strategy to Improve the Level of Students' Ability at All Levels

Now, I take the teaching practice of dialogue class and vocabulary course in the first part of PEP Elementary School English as an example to illustrate the design and implementation of the layered learning activities under the "Pizza-type" study group.

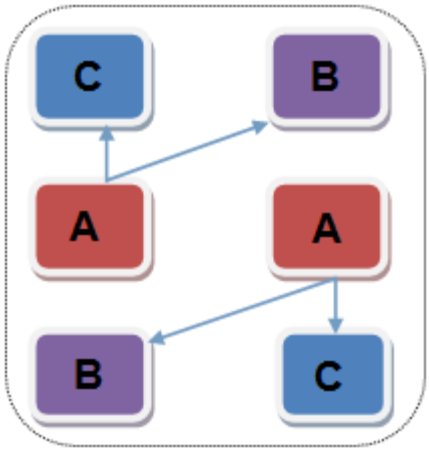
Dialogue Teaching – Close Cooperation in the Advanced Creation to Ease Differentiation and Promotion

Event Interpretation

Table 1 explains the detailed information regarding the Dialogue Teaching.

Event Analysis

Figure 3. Schematic Diagram of the "Pizza Type" Study Group Seating Arrangement.



- ✧ Three-person study group, A students with the shortest distance, the most convenient to promote the support of C students, and B necessary to help. (3 people are heterogeneous in groups, team building, and implementation of support.)
- ✧ The same table with 2 people, the two A students at the same table, easy to stimulate the enthusiasm of outstanding students, strong combination, achieve 1 + 1 > 2, create wonderful. (2 people of the same quality at the same table, layered teaching, promote excellence.)
- ✧ Six-person study group to facilitate project cooperation and carry out comprehensive learning activities, such as creating a dialogue on the theme of the unit, and actually using performances. (6-person group, strengthen cooperation and promote communication.)

Optimize job design and strengthen team cooperation. The traditional mechanized copying operation is replaced by cooperative design work, and the students' thinking ability, writing ability, oral expression ability and cooperation ability are exercised (Wang, 1999).

Focus on resource generation and foster cooperation awareness. In the process of expanding the creation and dialogue, we will carry out multi-form, multi-level interactive cooperation, high-density training of listening and speaking skills, and provide guarantee for the development of all employees.

Vocabulary Teaching – High-Density Cooperation in Game Confrontation

Event Interpretation

Table 2 explains the detailed information regarding the Vocabulary Teaching.

Event Analysis

Table 1. Event Interpretation - Dialogue Teaching.

A Let's Talk Event Name : Dialogue Creation In Our City (Our City) Applicable links: expanding the application stage Materials required: Group city map Time required: ~10 minutes		
Activity Step	**Specific Operation**	**Plan for Design**
1. Design a city map to create a brief dialogue	The three-person team designed a city map and asked: One person layout design; 1 person drawing place; One person writes a word. The three people described the introduction together.	1. Clear the division of tasks and give full play to the strengths of each team member. 1. Review the sentence patterns and vocabulary according to the map question and answer drill. 2. Provide contextual material for dialogue teaching.
2. Dialogue creation demonstration	Please stand three A-level language students and teachers based on the context, the temporary compose dialogue.	2. Support for students to facilitate cooperation. 3. To satisfy the desire to express, to generate wonderful, to form a demonstration.
3. The group created a performance	1. Cooperate to create a dialogue and performance according to the language brackets and materials provided in step 2. 2. The teacher asked the students according to the group dialogue.	1. Make sure the task is to achieve full participation. 2. The best listening group selection, optimize classroom control.

Teacher role conversions, from the front of the stage retreat behind the scenes. The activity "lightning reaction" is very interesting, the difficulty is progressive, the target spirals, and the training of listening, speaking, and reading and writing is combined to stimulate the enthusiasm of all students to participate.

Student responsibility is clear, from passive observers to active participation. 10 minutes of group cooperation learning, individual responsibility is clear, and actively interdependent, achieving cooperative learning, and real learning has taken place.

Exploring the "Multi-Dimensional" Evaluation Mechanism to Stimulate the Autonomy Development Appeal

Let students evaluate touched every level of inner needs, so that each student has the pursuit of goals within reach.

In the "Pizza-type" study group practice, we have tried the mechanism of "individual three-level evaluation" and "cooperative three-dimensional evaluation", which is

Table 2. Event Interpretation – Vocabulary Teaching.

A Let's Learn

Event Title: Competitive Games Quick response (lightning reaction)

Applicable links: consolidation and drilling stage

Required materials: a set of blank cards for each group

Time required: ~10 minutes

Activity step	Specific operation	Plan for design
1. Make a word card (2 minutes)	The team collaborates to make cards. C-level students distribute cards and say the name while distributing. B-level students check for errors. A-level students are responsible for the writing evaluation of B- and C-level students.	1. Check C-level students' mastery of the word sound, meaning and shape, find problems in time, and give help. 2. Combine the words with the words, combine the meanings, and practice writing.
2. Read words in the group (1 minute)	A-level students are responsible for the correction and evaluation of B-level students, and B-level students are responsible for C-level students.	The cascaded chain is responsible for correcting the evaluation, cultivating the team members' sense of cooperation, and cultivating the individual's sense of responsibility for learning.
3. put spell maps forum (2 minutes)	The three people used their own word cards to spell the city map, and used the sentence pattern "It's next to the..." to answer the questions of the other two members: "Where is the...?"	1. Within 2 to 1 rounds of questions and answers, use real situations to communicate and train language skills. 2. Grouping within 2 groups, training cooperation ability, and preparing for the subsequent inter-group PK competition.
4. Lightning reaction PK (5 minutes)	1. Each time two C-level students came to the stage to listen to the instructions to grab the blackboard card, and the students in the audience asked questions. The winner earns points for the group. 2. The following students are referees, using their hands and fingers to score separately.	1. Group C students took part in the PK competition to strengthen the pertinence of cooperative learning and improve the efficiency of cooperative learning. 2. Questioner, bidder, referee, teacher, and high-density cooperation between the four parties on the stage and on the table to improve the teaching efficiency per unit time.

intended to stimulate the internal motivation of students at all levels, cultivate the cohesiveness of group learning, and promote each The development of students' English proficiency (Wang, 2003).

Individual Three-Level Evaluation – To Promote the Improvement of All Students

According to the ability level of the three levels of students, three levels of learning objectives are proposed, three levels of activity evaluation are carried out, and three levels of dynamic individualized English learning formative evaluation are recorded.

Excellent Students – Solid Foundations outside the Classroom

For students with strong English learning ability, we pay attention to the students' solid grasp of the knowledge and skills of teaching materials, pay attention to the accumulation of extracurricular knowledge, cultivate students' habit of active learning and the awareness of helping others. Individual evaluations are subject to a one-stage evaluation by subject unit learning.

Medium Students – High Benchmarks and Incentives

For students with medium learning ability, our goal is to strictly implement the requirements of the curriculum standards, to grasp the content of the teaching materials, to expand appropriately, and to increase the extracurricular accumulation. The various learning contents are required by the excellent level, encourage medium school students to compete for excellence and enthusiasm within the student's ability.

Learning Weak Students – Lowering Standards and Rebuilding Confidence

For the weak students, we will focus on evaluating the growth and progress of all aspects, "lightening the shortcomings with bright spots" and "increasing self-confidence with progress", and rebuilding the learning confidence of weak students through key attention, vertical comparison and praise.

Three-Dimensional Evaluation of Cooperation – Promoting the Development of Cooperation Capabilities

Guide students to learn to cooperate, achieve the goal of multi-win development for all members, and plant the seeds of "Happy-to-Cooperation" for students, and lay the foundation for the ability to cooperate.

Three-Person Group Evaluation

For the division of labor of the team members, activity discipline, participation of each member, report of group cooperation results, etc., each unit selects the "Best Three-

Way" group to promote the three-person study group to improve cooperation effectiveness.

Six-Person Group Evaluation

In the "Pizza-type" study group, the two 3- person groups are both confrontational and cooperative. We evaluate the activity discipline, cooperation tacit agreement, and results reporting. Each unit selects the "Best Six-person Group" to create a healthy Cooperation and competitive atmosphere.

Overall Evaluation of the Whole Class

From the aspects of preparation, listening, speaking, cooperation, hardworking, etc., each class carries out an overall evaluation, and the team scores are included in the unit points to strengthen classroom control and build an efficient classroom.

Acquired: Smart Creates Vivid, and Vivid Creates Wonderful

Class Activities "Bystanders" Disappeared

Under the "Pizza-type" study group, everyone has something to do, everyone has something to do, each member has a full set of tasks, everyone has a clear goal, and the "bystander" disappears. The class is alive.

Learning Enthusiasm "Excellent, Weak" Continues to Be High

Under the "Pizza-type" study group, everyone in the group is responsible, and the "Excellent, Middle and Weak" three-level students are actively promoting the group in helping, correcting and reporting. The classroom atmosphere warms up (**Figure 4**).

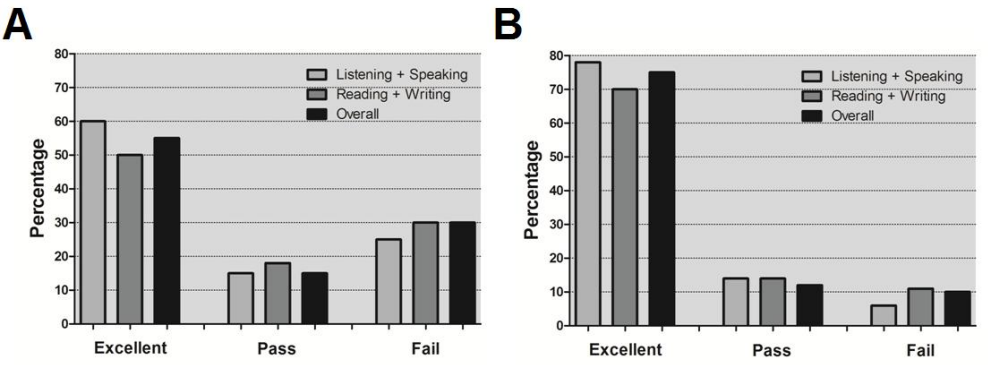
Learning Results "Barbell" Changes Quietly

Under the "Pizza-type" study group, students participate in mutual aid development, and the implementation of the "layered" learning and evaluation strategy has improved the ability level of students at all levels. The state of education and teaching throughout the classroom has undergone dramatic changes. A year later, the sample grade students whose grades improve significantly, the polarization phenomenon has been some relief, "bar bell" shape changed (**Figure 5**).

The establishment of the "Pizza-type" study group and the implementation of the teaching and evaluation activities can help the classroom to create exciting. In the follow-up, we will further improve its formation strategy and evaluation system, further study the stratification teaching evaluation strategy, and help each child's healthy development.

Figure 4. Classroom Atmosphere after Pizza-type Education.

Figure 5. Grade Changes after Pizza-type Education.



A: The fifth semester of the 2016 semester. B: The second semester of the 2017 school year, the sixth grade English final grade.

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ORIGINAL ARTICLE

Research on the Construction Path of High-level Universities under the Background of "Double World-Class" in China: Taking Jiangsu Province as an Example

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Abstract: Under the background of China's "Double World-Class" construction, the paper takes high-level universities in Jiangsu Province as the research sample, and adopts a case study method to study the connotation of high-level universities, the effectiveness and problems of high-level university construction in Jiangsu Province. Based on this, the path selection of high-level university construction in Jiangsu Province is proposed, which is to optimize the education structure, clarify the school goals, strengthen the discipline construction, improve the education evaluation mechanism, enhance the level of education internationalization, enhance the ability of serving economic and social development, and promote Jiangsu Province marching from the "Great Province of Higher Education" toward "Strong Province of Higher Education".

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***Keywords**: Double world-class; High level university; Construction path; Jiangsu province*

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***Conflict of Interests**: None.*

THE world-class university is not only the main symbol of the development level of a country's higher education, but also an important embodiment of the comprehensive competitiveness of a country. "Without a world-class university, a big country can make a breakthrough in some way, and a small country can also achieve national prosperity. However, looking at the history of modern world, there is no big country that can truly become a world leader with comprehensive leadership in the face of backward education." (Shi et al., 2008) Since 1995, China has successively implemented construction projects such as "211 Project", "985 Project", "Advantage Discipline Innovation Platform" and "Featured Key Discipline Project" etc. Focus on building a number of key universities and key disciplines, and improve the overall level of China's higher education. In 2015, the State Council issued the "Coordinating and Promoting the Overall Plan For World-Class Universities and First-Class Disciplines" and proposed the grand goal of building world-class universities and world-class disciplines (referred to as "Double World-Class"), and blew the "Assembly Horn" for the country's universities to sprint for staying and leading in the forefront, and create the world's top institutions.

In order to connect the country's "Double World-Class" construction, all provinces and cities have successively formulated high-level university construction and first-class discipline cultivation programs, set off a campaign to become a strong province in higher education, and to promote "China's higher education enters a new era of regional development" (Zhou, 2016). In 2016, Jiangsu Province issued the "Jiangsu High-Level University Construction Plan" to comprehensively launch the construction of Jiangsu high-level universities. Through the implementation of the strategy of high education and strong provinces and high-level university construction projects, Jiangsu Province has gradually been marching forward from a great province to a strong province in higher education.

The Connotation of High-level Universities and Their Construction Standards

At present, there is no objection to the importance of high-level university construction in both the education sector and the academic community, but what is the reason for it is still inconclusive. Throughout the history of China's higher education development, the concept of "high-level university" was gradually formed during the implementation of the "211 Project" and "985 Project". Some scholars believe that high-level universities are a comparative, spiritual, academic and developmental concept, which is the unity of personal values and social values, social and educational, ideal and realistic (Xu, 2010). Meanwhile, some scholars have revealed the essential characteristics of high-level universities from two perspectives: concept and entity, "From the perspective of concept, it can be divided into four dimensions: comparative, ambiguous, spiritual and constructive. From the perspective of entity, it can be divided into three levels: spiritual level, institutional level and technical level." (Zhai et al., 2010) However, some scholars

have explained the basic connotation of high-level universities: 1) Uncertainty. There is no clear boundary between high-level and non-high-level universities. 2) Dynamic. High-level universities are not static, but dynamic. 3) Relativity. High-level universities are just relatively assessed (Lv et al., 2011). In general, high-level universities are a comparatively relative concept. The historical background analysis from the concept of high-level universities has its original meaning corresponding to world-class universities. At the same time, some studies have revealed that high level universities can reach a relatively higher level in some respects than the average universities.

The proposal of high-level universities is not only the transformation of the concept of higher education development, but also the transformation of the development path and mode of colleges and universities. So, how to judge whether a university is a high-level university? In addition to reference to world-class university evaluation standards, such as Essential Science Indicators (ESI), QS World University Rankings, Times Higher Education World University Rankings (THE), Academic Ranking of World Universities (ARWU), etc., Chinese scholars have also conducted special research on high-level university construction standards. Some scholars believe that "see if it can produce and reproduce the social capital on the existing basis to meet the development needs of college students, university teachers and other related subjects (Dong et al., 2015). Some scholars have suggested that the characteristics of high-level universities should be selected, that is, "having excellent conditions for running schools, having first-class teachers; cultivating first-class talents; developing high-level disciplines and scientific research; conducting extensive international cooperation and exchanges; The charter and management system implements high-quality and efficient management; assumes due social responsibility and becomes a think tank and think tank for national and local economic and social development." (Wang et al., 2014).

Analysis of the Effectiveness of the Construction of High-level Universities in Jiangsu Province

The construction of high-level universities in Jiangsu Province is government-led, with the school as the main body, following the principle of "combination of overall promotion and classification guidance" and "combination of comprehensive reform and special reform", and formulated and issued a series of high-level university development. Strategic measures to promote the acceleration of higher education from the expansion of the main focus to the improvement of the connotation, laying a solid foundation for the construction of a world-class university. Nowadays, the number of colleges and universities in Jiangsu Province ranks among the top in the country, and the main indicators of higher education connotation construction are also among the best in the country.

The Construction of the Teaching Staff has been Continuously Strengthened

With a first-rate faculty and top-notch students, it is one of the most prominent signs of a world-class university. Jiangsu has implemented talent programs such as "Outstanding Contribution Experts", "Blue Engineering", "333 High-level Talent Cultivation Project", "Six Talent Summits" and "Specially Appointed Professors" to cultivate a group of high-quality teachers. Colleges and universities provide first-class teaching and research facilities, create a good working atmosphere, and enable teachers to have more autonomy and more time to engage in teaching and research. According to statistics, a total of more than 100 thousand full-time university teachers are in the province, of which 85 academicians, 198 Yangtze River Scholar Professor, 252 Winners of National Outstanding Youth Foundation people, and over a thousand of National Leading-level talents (Jiangsu Provincial Department of Education, 2016).

The Level of Discipline Construction is Greatly Enhanced

The discipline is the cell of the university, and building a world-class university must be based on disciplines. Jiangsu takes the construction of key disciplines as a starting point, and strives to strengthen the connotation construction of key disciplines in universities by consolidating the direction of disciplines, building talented highlands, cultivating innovative talents, building high-end platforms, and producing major achievements. In the latest national subject evaluation rankings, Jiangsu's colleges and universities have 13 first-level disciplines ranked first in the same category in the country, accounting for 13.7% of the country; 79 of Jiangsu's 21 universities have entered the ESI database in the top 1% of the world's similar disciplines, ranking first in the country. The number of subjects entering the country ranks second in the country (Jiangsu Provincial Department of Education, 2016).

The Overall Strength of Scientific Research has been Significantly Enhanced

The university occupies an increasingly important position in the national innovation system. University research is the backbone of national science and technology innovation and has become an important force in the national innovation-driven development strategy. At present, there are 6,988 platforms of various science and technology bases in Jiangsu, including 5 "2011 Collaborative Innovation Centers", 52 national key laboratories, engineering (technical) research centers, and 15 national university science parks (Jiangsu Provincial Department of Education, 2016). During the "Twelfth Five-Year Plan" period, the province's colleges and universities received 50.13 billion CNY in science and technology funding, and 143,000 scientific research projects; 133 national science and technology awards and 326 outstanding scientific research awards (sci-

ence and technology) by the Ministry of Education (Jiangsu Provincial Department of Education, 2016).

The Quality of Talent Training has Improved Significantly

"University is the combination of scientific and technological progress and talent cultivation. It has an important mission in building an innovative country... In the many tasks of the university, cultivating innovative talents is its top priority." (Leading Group of Chinese and Foreign Principals Forum of the Ministry of Education, 2006) Jiangsu has implemented training programs for outstanding engineers, outstanding teachers, outstanding agricultural and forestry talents, outstanding cultural and artistic talents, and constantly explores innovative, applied and compound talent training models. The university regards talent cultivation as the core task of building high-level universities, continuously optimizes the professional structure, deepens the reform of personnel training mode, and cultivates top-notch innovative talents. At the same time, it draws on international advanced educational ideas and educational experience to introduce foreign high-quality educational and teaching resources, and trained a large number of international talents.

Continuous Improvement of Social Service Capabilities

In view of Jiangsu's economic development needs and industrial layout, combined with the development of science and technology in schools, the university will identify the areas of scientific and technological cooperation that are in line with the development of Jiangsu's industry, and give full play to the technical support, talent support, introduction and digestion, innovation support and frontiers of universities in the industry-university-research alliance. The role of strategic decision support in the field Nanjing University adheres to the service concept of "serving Jiangsu and radiating the whole country". It has four core businesses: the construction of political, academic, research and innovation, the construction of a business incubator platform, the construction of a science and technology consulting service platform, and the construction of an international technology transfer platform. A total of 26 Industry-University-Research cooperation platforms have been established including Nanjing University Changshu Ecological Research Institute and Nanjing University Yancheng Environmental Protection Technology and Engineering Research Institute (Nanjing University, 2016).

The Problems in the Construction of High-level Universities in Jiangsu

Nowadays, "University has become an indispensable thing for economic development and national survival. (Ashby, 1974)" Jiangsu Province is the first in the country to pro-

pose the construction of a province with high education, take the lead in promoting the construction of advantageous disciplines, actively promote comprehensive reform of higher education, and continuously improve the overall education. Strength and high-level university construction have also steadily advanced. Guided by the strategy of strong province by higher education, Jiangsu's high-level universities have taken a connotative development path and have achieved certain results and accumulated valuable exploration experience, but there is still a big gap compared with world-class universities.

University Education Level and Regional Distribution are not Balanced

At present, among the only two "985 Engineering" universities in Jiangsu, only Nanjing University can be called the top domestic university, but there is still a big gap from the world's top universities. In "QS 2018 World University Rankings", Nanjing University ranks 114th and Southeast University is only presented after the 500th (QS, 2018). In addition, there is a large gradient gap in the development of higher education in Southern, central and Northern Jiangsu, and high-level universities are mainly concentrated in Southern and Central Jiangsu. Although higher education in Northern Jiangsu has developed rapidly in recent years, it is still relatively weak. This backward situation has seriously affected the economic and social development and talent cultivation in Northern Jiangsu, and has restricted the construction of a strong province of higher education in Jiangsu Province.

Universities Lack the Characteristics of Running a School

In the era of higher education popularization, higher education plays multiple roles. It satisfies the various needs of learners in different ways, so more emphasis should be placed on the diversity of higher education (Westerheijden, 2003). Therefore, high-level universities must have their own characteristics, and they must develop new features and create new advantages while maintaining their own characteristics. After experiencing scale expansion and connotation development, most universities in Jiangsu have clearly defined their own positioning and development goals. However, compared with the world-class universities, the mode of running a university in Jiangsu still does not break the pattern of "One thousand schools with one face" formed under the traditional planned economic system. The goal of talent training tends to be more abstract and generalized, and the educational concept is not clear enough to highlight the characteristics of each school.

University Discipline Barriers Still Exist

Disciplinary construction is the carrier and support of scientific and technological innovation in universities, major discoveries and breakthroughs in the field of science and

technology. Every progress in society and the birth of any emerging industry are closely related to the development and innovation of disciplines (Wu, et al. 2013). At present, The internal and external institutional barriers between universities and universities in Jiangsu Province have caused the division of scientific and technological resources, and the allocation of resources is scattered, closed and inefficient; Repeated construction of scientific research facilities and data materials, it is difficult for science and technology resources to be integrated and configured according to the innovation chain and industrialization rules, resulting in resource shortage and idle waste. There are too few contacts among professors in various departments within the university, and the rigidity and lack of exchanges and cooperation between various departments have caused many scholars and scientific researchers to limit their intelligence to their own small scope." (Huang, 2006)

The Educational Evaluation Mechanism is not Sound

Daniel L. Stufflebeam, an American education appraisal expert, puts forward: "The purpose of educational evaluation is not to prove, but to improve." (Stufflebeam, 1966) At present, the evaluation of higher education in Jiangsu mainly includes the examination and evaluation of undergraduate teaching work, the professional certification of teachers, and the evaluation of new professional programs. There are still many problems in the process of educational evaluation, such as the single subject of evaluation and the lack of initiative in colleges and universities; The evaluation indicators are unified, and there is a situation in which "a ruler measures different types of colleges and universities", which is difficult to reflect the characteristics of various universities; The evaluation results are not convincing, and the social recognition is low, etc. Moreover, the quality responsibility of colleges and universities is low, the quality and culture concept is weak, and there is no perfect internal quality guarantee mechanism.

Low Level of Education Internationalization

The wave of economic globalization has brought higher education into the era of "new internationalization." Internationalization is regarded as an important indicator for measuring the quality of higher education. It has become a major topic of concern to governments, higher education institutions, student organizations and certification bodies around the world (Wit, 2010). As Professor Ulrich Teichler (2003) of the University of Kassel, Germany, said: "Internationalization is no longer a matter of the few top universities, and all universities must be internationalized to some extent." Currently, although the level of internationalization of higher education in Jiangsu has gradually improved, compared with developed countries, the internationalization indicators such as faculty, curriculum, scientific research cooperation, foreign student training, and Sino-foreign cooperative education are still at a low level, and the structure needs to be optimized.

The Ability of Universities to Serve Economic and Social Development is Low

In today's world, whether it is building a world-class university or building a high-level university, it is necessary to put research and innovation and social service capabilities at an important position (Zhao, 2008). In recent years, the main strategies, technological innovations and service capabilities of Jiangsu's colleges and universities in service economic development have been continuously enhanced. However, the awareness of economic and social development in the service areas of universities is relatively weak, and the overall service capacity of the society is not enough. The combination of universities and economic and social development is not close, and the discipline construction is separated from the needs of regional economic and social development. The ability of universities to serve Jiangsu's economic transformation and upgrading needs to be improved, especially in terms of personnel training, technological innovation and transformation of results.

The Path Selection of Jiangsu High-level University Construction

In the face of increasingly fierce international competition, universities have become an important factor affecting the competitiveness of a country. As the famous Spanish politician and educator Ortega Y. Gasset (1930) said: "A great country must have a great school; likewise, without a great school, it will not be a great country." Under the "Double World-Class" construction strategy in China, the construction of high-level universities in Jiangsu should continuously improve the top-level design, learn from the advanced experience of domestic and foreign universities, and explore the development path based on its own reality.

Implement classification development and optimize the structure of higher education

World-class universities have their own characteristics in terms of school philosophy, discipline structure, and system construction. Harvard University Honorary President Neil L. Rudenstine pointed out "Good universities are not all comprehensive and research-oriented. Different types of universities should have different goals. Even research universities are not the same." (Liu, et al., 2002) Jiangsu should adjust the structure of higher education in combination with the needs of talents and industrial development needs in the region, promote the construction of high-level universities, and enrich the diversity of higher education systems. Policy design should encourage university level stratification, give more choices to universities, localities, students, etc.; encourage higher education institutions to position different missions and develop a

strategic picture with characteristics. “Isolated mountain peaks can no longer dominate this landscape. The stars are more splendid than the lone star, and they can brighten up the night sky.” (Kerr, 1964) The university should further promote the comprehensive reform of education, actively explore the road of diversification, quality, specialization and internationalization, and strive to build Jiangsu Province into a pilot zone and demonstration zone for deepening reform of higher education.

Clear School Goals and Scientifically Develop Development Plans

The idea is the value orientation and personality characteristics of the university. It is the soul of the development of the university. The pioneer of the concept will bring the overall leap of the university. Compared with world-class universities, the problems faced by Chinese universities are most likely to be conceptual and institutional gaps. The famous American educator Ernest L. Boyer (1987) said: “A high-quality university must have a clear and vibrant goal of running a school. It can’t be a hodgepodge that meets all the requirements of all. It needs to make choices and determine which ones should be considered.” Therefore, scientific concepts, lofty missions, outstanding goals, advanced culture, and an atmosphere conducive to innovation are indispensable factors for high-level university construction. At the same time, the university must have a global vision, focus on long-term and sustainable development when formulating the plan, and must be based on China’s national conditions and the specific reality of the school. It must have inspiring development goals as well as specific measures to achieve the goals.

Strengthen Discipline Construction and Cultivate Top-notch Innovative Talents

American higher educator Burton R. Clark (1983) proposed: Knowledge is the logical starting point of higher education; “high-level knowledge is at the core of the purpose and essence of any higher education system” Discipline is the form of deep knowledge existence and the foundation of high-level university core competitiveness, which determines that universities must attach importance to discipline construction. “The concept of discipline construction is the deepest and most core content of the university’s educational philosophy. It is called the soul of creating a world-class university.” (Clark, 1983) The discipline construction of Jiangsu high-level universities should be based at the forefront. The development of disciplines is aimed at “academic cusp”, promoting discipline integration, cross-cutting, complementarity and transformation and upgrading, creating new disciplines and opening new directions. Belgian scientist I. Prigogine predicted: “The 21st century is a century of comprehensive science or cross-science.” (Prigogine, 1987) In the process of discipline construction, universities should set up various interdisciplinary research centers and form interdisciplinary research groups so that “disciplines will not be separated from each other, but will be integrated through a rea-

sonable principle" (Hutchins, 1936); develop interdisciplinary training programs and plans, break down barriers between disciplines, enhance interdisciplinary penetration, and vigorously cultivate top-notch innovative talents.

Improve the Evaluation Mechanism and the Quality of Higher Education

With the popularization of higher education and the increasing resources of university control, the accountability system that emphasizes the overall performance of the university as a target of evaluation rises globally. The administrative department of education in Jiangsu Province should establish a scientific and perfect evaluation mechanism for higher education quality, and promote the transformation of educational evaluation function from "quality assurance" to "quality improvement". First; we must develop a scientific and reasonable performance evaluation index system. According to different types of construction of universities and projects and their different construction stages, select different performance evaluation indicators. Second, we must introduce third-party evaluation. Actively explore the establishment of a long-term mechanism based on social evaluation, and introduce third-party professional evaluation agencies to participate in high-level university construction performance evaluation. Third, we must establish incentive and exit mechanisms. According to the performance evaluation and evaluation, the key construction of universities and projects will be dynamically adjusted. At the same time, as the first person responsible for the quality of education, colleges and universities should strengthen quality responsibility, strengthen the construction of connotation and quality culture, and continuously improve the quality of their education.

Expand Education Opening and Improve Internationalization Level

Today, no country, government, university or other organization can evade the influence of globalization, and no individual in social life can enjoy the globalization process. Universities must be open to the entire realities of their time, must be born in a real life, and must be integrated into the external environment (Gasset, 1930). According to the national "One Belt, One Road" initiative, Jiangsu should continuously promote educational exchanges and cooperation with relevant countries (regions), and vigorously support various provinces and universities along the belt line to carry out various forms of exchanges and cooperation. Colleges and universities should actively attract international innovation forces and resources, gather world-class experts and scholars to participate in discipline construction, cooperate in cultivating international talents, promote substantive cooperation between disciplines and relevant foreign research institutions, and accelerate the international development of discipline construction; Exploring a new model of international education, comprehensively applying the forms of cooperation, introduction or blending, and broadening the international development of Jiangsu high-level universities.

Give Full Play to Professional Advantages and Serve Economic and Social Development

Nowadays, "Knowledge is the core of society. More and more people and more and more institutions have never needed or even required knowledge as they do now. As a producer, wholesaler and retailer of knowledge, universities inevitably provide services to the society." (Kerr, 1964) Jiangsu vigorously supports the comprehensive reform of colleges and universities, strengthens the cooperation of similar majors in universities and colleges, and builds professional groups that can meet the needs of Jiangsu's industrial structure optimization and adjustment, highlighting the level and characteristics of colleges and universities; continue to promote the deep cooperation between universities and industry enterprises, and explore a new model is built by industry, localities and universities. Colleges and universities should implement the concept of "Based on Jiangsu, integrating into Jiangsu, Serving Jiangsu, and Developing Jiangsu", and strive to adapt, serve and lead Jiangsu's economic and social development. At the same time, it is necessary to actively combine the advantages of its own disciplines and local industrial characteristics, strengthen communication and cooperation with local governments and science and technology education departments, solve practical problems for local development, and promote the win-win development of schools.

Conclusion

"Universities are in the general social structure of a particular era rather than outside. ... It is a manifestation of the times and a force that affects both now and in the future." (Frexner, 1930) In the era of knowledge economy, high-level universities have become the core competitiveness of the country and have played a leading and leading role in promoting national economic and social development. The university is now "second only to the government as the main provider of society and the main tool for social change..., it is the source, advocate, promoter and communication center for new ideas." (Brubacher, 1978) The university has changed from the "ivory tower" to the "power station" and "booster" of social progress in the modern era.

"Great universities were developed during the great period of great political entities in history." (Kerr, 1964) With the deepening of the popularization of higher education in China, the reform and development of higher education faces unprecedented opportunities and challenges. Promoting the construction of high-level universities has become an important measure to accelerate the construction of a province with high education and promote regional economic development under the new situation. China's "Double World-Class" construction project has provided a new opportunity for the construction of high-level universities in Jiangsu, and created favorable conditions for the realization of the goal of "Strengthen Province by High Education". Jiangsu Province should closely combine the problems and development opportunities faced by China's higher education, learn from the beneficial experience of developed countries in

developing higher education, increase reform efforts, accelerate the pace of development, and promote the construction of high-level universities to achieve connotative and leap-forward development, and the quality of personnel training, research and innovation, and social service levels have been significantly improved.

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ORIGINAL ARTICLE

Project-Based Learning in Chinese Middle-School Students Is More Effective than the Traditional Teaching Method: An Experimental Study

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Abstract: This study explores the teaching method of project-based learning (PBL) compared to the traditional teaching method in Chinese schools by investigating the effects of PBL on junior school students. A teaching unit lasting two weeks on inheritance and genetics was used as curriculum and student achievement compared between an experimental group (n = 107) where PBL instruction was used versus the control group (n = 103) where standard traditional classroom instruction was used. Students in the PBL group had significantly higher scores in learning procedure (d = 1.003), achievements (d = 0.566) and students' self-assessment (d = 1.539). The overall effect size for the PBL group was d = 0.989.

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Literature Review

PROJECT-based learning (PBL), honored as a 'most striking innovation,' holds great interest as a new teaching method (Li, 2010). The method is based on using real-life events for learning. In this learning process, teaching objectives are met by having students complete projects related to the curriculum in the context of real-life situations. The procedure in PBL is for students to: 1) collect information and initiate a project based on the questions provided by teacher or themselves; 2) establish a group, discuss possible projects and form a project plan; 3) execute the project; 4) present project results and conclusions (Li, 2018). Rather than being teacher-, class-, or textbook-centered, PBL is student-centered, relying on the initiative of students to learn. As students carry out projects, they integrate knowledge from numerous subjects and present visual results; this ensures their cooperation, problem-solving and critical thinking abilities are well-trained. Students gradually become skilled communicators and advanced problem-solvers (Li, 2010; Chen, 2017; Bell, 2010). In view of the unique advantages of PBL as a teaching tool in personnel training, local governments and schools in many countries have begun to embrace the use of PBL in a variety of courses. Existing studies indicate that development of PBL-related courses is beneficial to students' future education and career development (Ralph, 2015).

In recent years, some regions and schools in China have begun to explore PBL as a teaching method (Zhang, 2019; Song, 2019). However, Chinese teachers are constrained to teach according to an established teaching plan and content framework, unlike teachers in European and American countries that often have more flexibility to determine their own teaching method and content. This limits Chinese teachers' ability to implement PBL. Moreover, Chinese teachers are accustomed to traditional teaching methods and student-centered teaching concepts, which weaken the promotion and implementation of PBL in China. To date, few cases of PBL in Chinese classes exist and empirical research concerning curriculum design, operational process and evaluation of effects for PBL as a teaching method is especially lacking. Therefore, this study explored the curriculum design and procedures of PBL within the context of the environment and requirements of China's education system to assess the effect of PBL on students' learning procedure, achievements, and self-assessment. Lessons on genetics taught in junior high school were used as an example, with a focus on the teaching unit 'biology inheritance.'

Research Design

Participants

The study included 219 students in four classes in a junior high school in Huaian, Jiangsu Province. It is one of the best schools in Huaian with students in this region random-

ly allocated to this school. After questionnaires and classroom observations, 210 valid samples remained, including a control group (n = 103) where students received traditional teaching and an experimental group (n = 107) where students received PBL instruction. Students in four class received introduction from the same teacher, and the only difference between experimental and control group was difference in teaching method. Two classes participated in control group and the number of students is 50 and 53 separately. The number of two classes in experimental group is 52 and 55. Students' pre-experiment scores, family background, and gender ratio did differ significantly between groups, indicating that control and experimental groups were equivalent.

Research Method

Since no authoritative scale met the needs of this study, a questionnaire was designed specifically for this study. The questionnaire included 15 questions about students' learning effects and self-efficacy, including learning procedures, achievements in genetics, and students' self-assessment.

Learning procedure. This dimension explores students' learning methods under different teaching modes to ascertain whether PBL improves students' self-learning ability. Five questions were included: 1) I have investigated the genetic phenomena between my parents and myself; 2) I have learned the relationship among DNA, genes and chromosomes through many methods; 3) I have investigated the application of DNA in life; 4) I have carried out cooperative learning in this unit; and 5) I have carried out independent research in this unit.

Achievements in genetics. This dimension compares students' learning achievements under different teaching modes. Four questions were included: 1) I understand knowledge about genes, and chromosomes; 2) I understand the concept of traits and can give some examples to explain; 3) I can use pictures to express the relationship between DNA, genes and chromosomes; and 4) I can design a program to help lost children find their families.

Students' self-assessment. This dimension compares students' self-assessment under different teaching methods. Six questions were included: 1) I am interested in the learning content of this unit; 2) My cooperative ability has been exercised in this unit learning; 3) I learned how to better solve problems in the learning of this unit; 4) I liked the teaching methods of this unit; 5) My ability has been improved in the learning of this unit; and 6) I have gained a new understanding of biology curriculum in the learning of this unit.

Each question had five possible rating levels: agree strongly (5), agree (4), neither agree nor disagree (3), disagree (2), and disagree strongly (1). Thus, the higher the score, the more the better the student had learned. Cronbach's α and Kaiser-Meyer-Olkin are 0.923 and 0.926 for the whole questionnaire, 0.764 and 0.671 for the dimension of learning procedure, 0.739 and 0.752 for the dimension of achievements in genet-

ics, and 0.965 and 0.905 for the dimension of students' self-assessment; these values indicate good reliability and validity of the questionnaire.

Intervention

The whole experiment lasted two weeks. During this period, according to the prescribed teaching content, teachers used two teaching methods to implement teaching in the experimental group and the control group respectively.

Research focused on the teaching content of inheritance in organisms to improve students' abilities in: understanding of DNA as the main genetic material; describing the relationships between chromosomes, DNA and genes; and giving examples of characteristics controlled by genes. In the experimental group, students were taught using the PBL method, while in the control group, students received traditional instruction. Students participated in pre- and post-intervention tests, which included the three dimensions discussed above to make comparisons between groups.

PBL instruction. Based on the central theme of the project, students' activities mainly focused on helping abducted children find their families. Three critical tasks proceeded as follows. First, after a teachers' brief introduction, students learned on their own to gain a deep understanding of genetics. Second, students flexibly applied their knowledge about genetics learned before to design and optimize solutions to the task through several team discussions. Third, after the presentation of plans from different groups, the class agreed on a final feasible plan to help abducted children find their families.

Control instruction. Teachers clarified concepts of chromosomes, DNA and genes to the whole class. Students had few opportunities to discuss the relationship among these concepts and when doing so had to follow teachers' lead and provide responses to teachers' questions. Student achievements were assessed by the teacher.

Results

Class observation

Anecdotal observations suggested student learning under PBL differed substantially from traditional teaching methods. Experimental students had greater enthusiasm for learning and a greater willingness to communicate and cooperate with teachers and classmates. In PBL, the principle of student-centered learning reconstructs the student-teacher relationship such that teachers act as coordinators to establish a system of curriculum knowledge with students rather than as leaders or controllers in the teaching process. Students have more opportunities to explore activities and to learn by themselves in order to accomplish learning tasks. Therefore, students participated in more activities and completed learning tasks through peer-cooperation. In this study, the task

of 'Finding Their Families' was designed to meet the PBL teaching goal and it required increased student involvement in the learning process.

Control students received the traditional Chinese teaching method, namely, the mainstream teacher-led, textbook-based teaching method. The teaching process was successfully completed. However, teachers imparted knowledge and students could only passively accept it. In teacher-student communication, teachers raised questions and students had to answer. Observations of this teaching method suggested that many students were distracted and found it difficult to follow the teachers and accomplish the necessary learning process.

Student Achievements

Effect size data were calculated as pre- minus post-test data. **Table 1** summarizes changes in scores for learning procedure, achievements in genetics, and students' self-assessment for students in the experimental and control groups. In the pre-test, no significant differences were present in the three dimensions between experimental and control students, implying that both groups were equivalent before learning about the 'Inheritance of Organisms.' In post-test results, experimental students had higher test scores than did control students for all scales, indicating a positive effect of PBL.

Specifically, the overall effect size of using PBL over the traditional learning method was large at 0.989 (a big effect size), indicating an overall benefit for experimental students. For the learning procedure dimension, was a big effect size d = 1.003, implying PBL encourages students' independent learning and involves them in the learning process. Effect size for achievements in genetics was medium at d = 0.556, indicating experimental students had increased knowledge mastery. The largest effect size occurred in the dimension of students' self-assessment, with d = 1.539, which was a big effect size for improving students' learning acquisition.

Discussion and Conclusion

This research compared traditional teaching methods with PBL methods and showed that PBL is an effective teaching strategy. Existing studies indicate that PBL can improve students' abilities in inquiry, program-design and decision-making (Doppelt, 2005). PBL also improves students' vocabulary in computer and science lessons (Bilgin, et al. 2015). Other results have found that PBL teaching encourages student interest in hobbies and careers related to engineering and technology (Sari, Alici, & Sen, 2018). Further, researchers and decision-makers are more willing to provide career recommendations for these students (Miles, Slagter, & Mensah. 2015). Compared with traditional teaching methods, PBL increases students' academic performance, improves students' motivation to learn and cultivates students' critical thinking (Karacalli & Knrur, 2014; Rajan, Gopanna & Thomas, 2019). Consistent with previously published research, our

Table 1. Pre- and Post-Test Means, Standard Deviation, and Effect Size.

	Pre-test				Post-test				
	Control (N=103)		Treatment (N=107)		Control (N=103)		Treatment (N=107)		Effect Size
	M	SD	M	SD	M	SD	M	SD	d
Learning Procedure	2.282	0.874	2.815	0.499	2.559	1.581	4.579	0.444	1.003
Achievement in Genetics	3.305	0.882	3.417	0.814	3.993	1.187	4.614	0.448	0.556
Students' Self-Assessment	1.319	0.422	1.216	0.243	3.277	1.465	4.623	0.511	1.539
All Dimensions	2.302	0.726	2.482	0.519	3.276	1.411	4.606	0.468	0.989

Control: the control group; Treatment: the treatment group; M: Mean; SD: Standard Deviation; d: Cohen's d

results suggest a positive impact on students' learning procedure, an improvement in their knowledge capacity and ability, and improved learning acquisition.

The small sample size, short experimental time and lack of random sampling by teaching level within schools of different regions limits the conclusions we can reach from this research. Nonetheless, as one of few empirical studies on PBL in mainland China, the research can provide a foundation for further research on, and use of, PBL in other regions.

Based on the results of this research, we are optimistic that PBL is relevant to China's curriculum design under current teaching conditions in China. Teachers are likely to worry about deterioration of students' scores when teaching via the PBL method, since good marks are considered a critical goal by teachers and schools. Results in this study should reduce teachers' concerns. PBL increased students' learning interest and improved their problem-solving abilities, cooperation and communication. Thus, PBL is an effective way for students to learn and deserves further exploration.

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