# A new team-based teaching method in numerical calculation courses

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ABSTRACT: Based on related theories of effectiveness and hierarchy regarding team-based learning, and combined with the teaching characteristics of numerical calculation courses, proposed within this article are a set of team-based teaching schemes which have excellent operability and extensibility. Taking team-based learning as the foundation, the mature and available teaching schemes cover team grouping, evaluation, team-based classroom teaching, group activity planning and other aspects. Actual practice shows that the schemes can not only greatly increase the enthusiasm and initiative of students, but also develop a spirit of mutual co-operation and competition.

## INTRODUCTION

In recent years, teaching modes and methods have seen much improvement with the development of multimedia information technology [1][2]. These developments provide extra tools and methods for teaching in the form of advanced courseware resource-sharing facilities, experimental simulation, on-line teaching, on-line assessment, etc. It is these tools that greatly upgrade and improve teaching modes and methods. In practice, team teaching has many different formats, but in general, it is a means of organising staff into groups to enhance teaching. Teams generally comprise staff members who may represent different areas of subject expertise but who share the same group of students and have a common planning period to prepare for teaching.

To facilitate this process a common teaching space is desirable. However, to be effective team teaching requires much more than just a common meeting time and space.

Research on team-based learning using these new tools has developed rapidly [3-5], but there are a lot of unresolved difficulties, including how to stimulate students' initiative, carry out student-centred teaching, enable a relatively objective evaluation of students' learning and deepen students' theoretical knowledge [6-8]. The authors in this article have aimed at these specific problems, and are reporting on teaching design and practice using inquiry and research-based learning taking account of the required course content and students' characteristics. This reflects student-centred education combined with existing practical teaching.

The new team-based teaching method has team-grouping principles covering scoring, classroom reform and courseware designation. There are three team-grouping methods. Appropriate team-grouping can ensure the fairness of scores with the level of study being measured by the team and individual scores. Classroom reform can inspire the study of teams and students.

## DESIGN AND APPLICATION OF TEAM-BASED TEACHING SCHEMES

### Discussion on Team-Grouping Methods

The organisational structure of team-based teaching lies in dividing the class into many teams. Every team elects a leader. A teaching task is assigned to and completed by the team. Team grouping is first considered. Team grouping should take the balance between teams into consideration [1][2]. As shown in Figure 1, three methods were adopted to build teams: one is to use student number order; the second is to assign students randomly; and the last one is to allow students to select their own group. Diverse team-grouping methods can ensure everyone has the opportunity to participate in different teams. Each team should have fewer than six students. Too small a number of students may not

allow for mutual assistance while learning and, it is hard for too many students to reach agreement [3][5]. Team leaders should be designated randomly or chosen from volunteers. If a leader does not perform properly, the team score will decline.

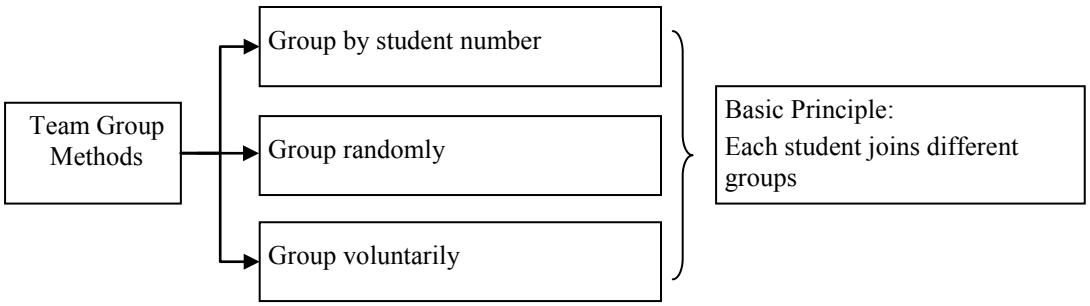


Figure 1: Team-grouping methods.

The evaluation system for teams and individuals is considered next [3]. A team will be awarded a score by other teams and teachers. This evaluation will take account of the completion of team tasks, posing questions and providing answers, and the presentation of the team's task. An individual score equals the team score plus an individual performance score, as shown as Figure 2. So, the team performance has a direct influence on the individual score and team cohesion.

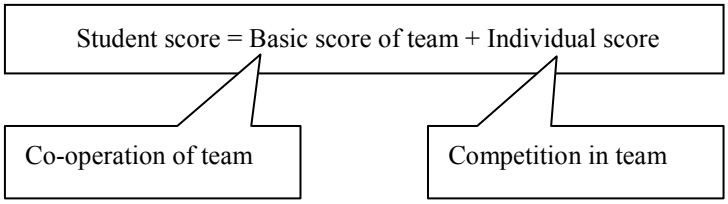


Figure 2: Assessment component of team-based teaching.

Classroom Teaching Reform of Team-Based Learning in Numerical Calculation Courses

A class lecture may be divided into many units. Units of a lecture are shown in Figure 3. The new team-based teaching method involves three or four different lecture units. The seats for students are arranged in a circle, as shown in Figure 3. The teacher delivers a lecture to the students. A question asked by the teacher is discussed by the students in each team. There are many group discussion methods, as shown in Figure 4. Different group activities can encourage every student to join in.

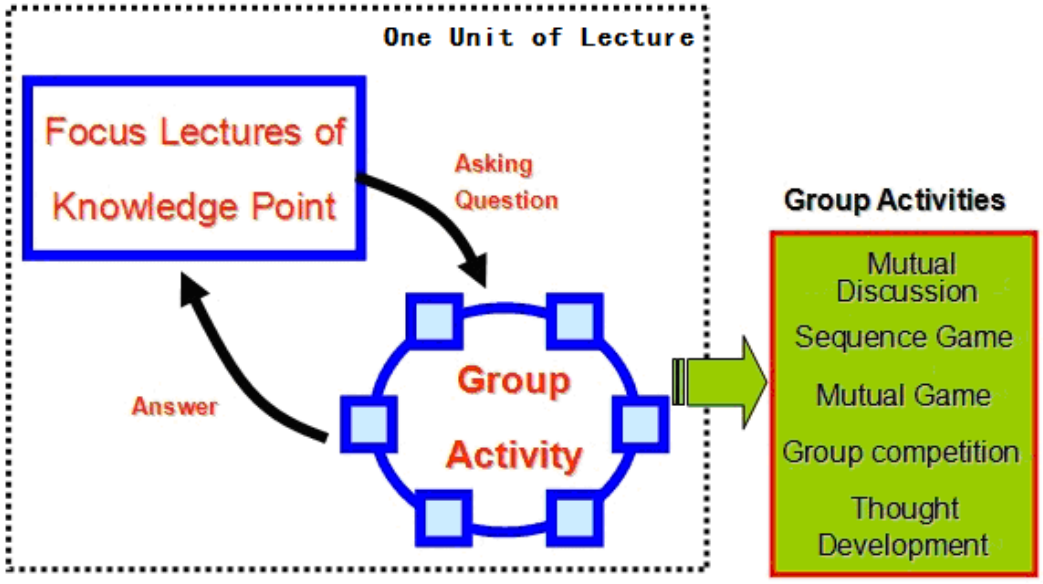


Figure 3: Design scheme for team-based classroom teaching.

Team-based learning requires teachers to organise teaching content around knowledge points. It should take 10-15 minutes for a teacher to teach each knowledge point, which can give students a sense of constant freshness and renewal.

The content of each knowledge point should cover principles, any relevant algorithm, a demonstration, examples and two-to-three questions related to the content of each knowledge point for team discussion. The goal of team discussion is to carry out self-learning within the team and to digest the material just taught. Various group activity examples in numerical calculation courses are shown in Figure 4. Mutual help is valued in team discussions and it allows those who know more to act as teachers. Team discussions should be limited to about five minutes. Afterwards, the teacher selects a team randomly or, where there is competition between teams, allows teams to volunteer to answer questions. Thus, teaching and learning of each knowledge point can be controlled to last about 30 minutes, enabling a highly effective co-operative and competitive learning mechanism.

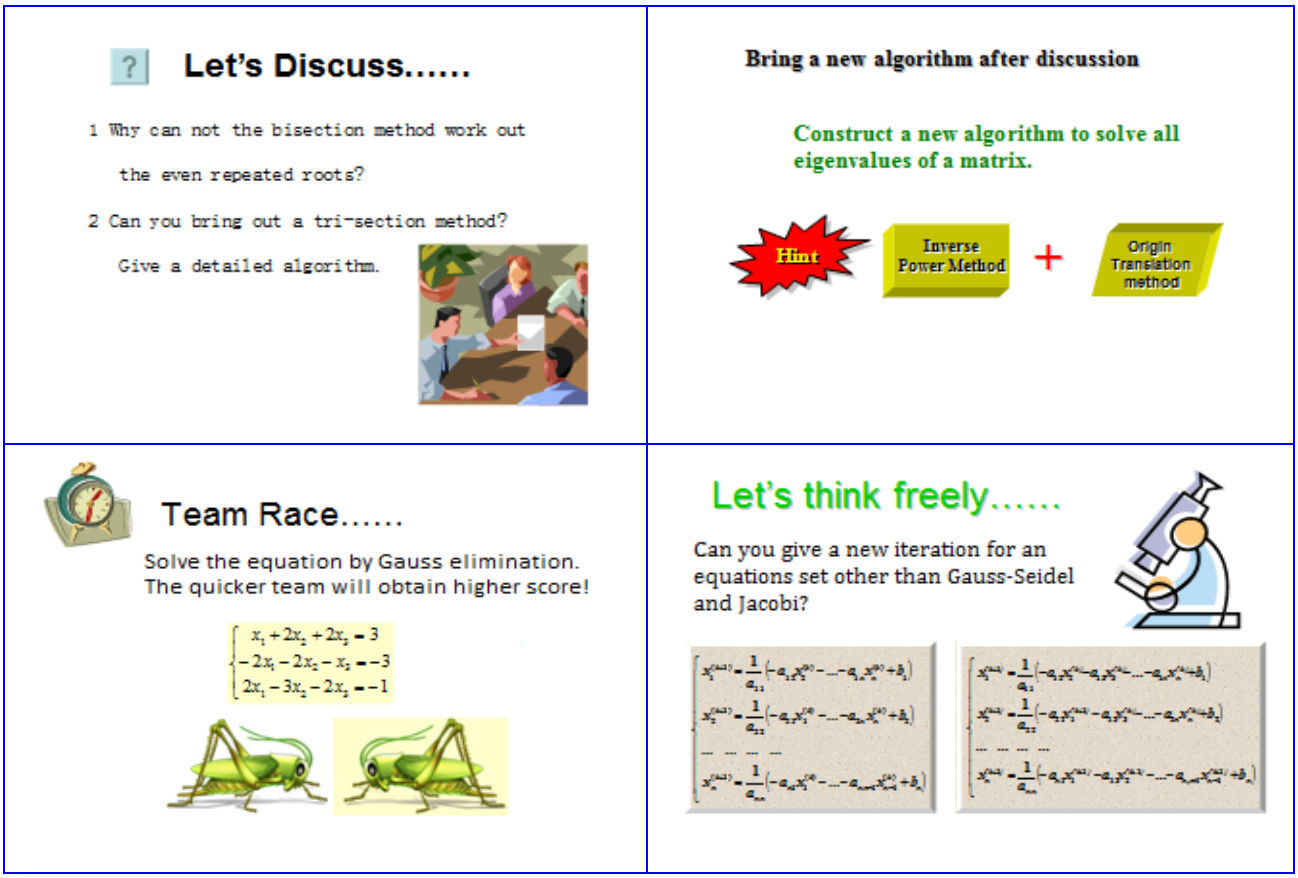


Figure 4: Various group activity examples in numerical calculation courses.

The actual scenes from the use of the new team-based teaching method are shown in Figure 5 and Figure 6.

Figure 5: The actual scene of the new team-based teaching method for *Telecom Class 091*.

Implementing a team-teaching approach requires administrative encouragement, acceptance that the initial quality may be adversely affected because of the experimental nature of the approach and a willingness to take risks. Proof that team teaching works comes not only from the instructors' judgment, but also from students' evaluation. Above all, team teaching cannot be accomplished by administrative fiat - but administrators need to encourage it.

The date of the class shown in Figure 5 was about October 2010. Each team had six students. Each student could chair one theme from the course. The students were motivated by competitive questioning. They were very happy to join the team activities.

The class shown in Figure 6 was photographed in about April 2011. Each team had five or six students. A substantial theme was assigned to each team. A team solved the theme question by mutual discussion, calculation, presenting a lecture, and so on.

Figure 6: The actual scene of the new team-based teaching method for *Communication Class 111*.

Typical Awareness from Team-Based Inquiry Teaching Activities and Related Improvements

Seen from students' questionnaires, there are three typical types of awareness of the teaching reforms when using this new type team-based learning for students:

1. Some students think they can fully express themselves in such a learning environment. These students are confident and they usually are actively involved in activities so ultimately they have high grades. Learning from team-based teaching can strengthen a student's organisational ability.
2. Some students hold that in such learning where activities are full of fun with fierce competition to get high scores, they can fully consolidate learned knowledge. These students are in the majority and co-operate well in activities. This type of learning results in an improvement in team co-operation and the competitive abilities of these students.
3. Some find it hard to adapt, and maintaining such learning by involving fierce competition between team members for high scores takes up time required for the basic study of theory. These students perform passively in team-based learning. They are satisfied with just studying the taught materials and are not ready to accept competition from other students. Though these students passively participate in competitive learning, it is still possible they will show some adaptability and that they will progress.

Based on the above classification analysis, the new type team-based learning scheme needs further improvement to increase the degree of student participation in activities for students indicated in Point 3 above and to reduce the resistance of these students. Teams take a variety of forms in different contexts. However, successful team teaching must go beyond sharing a group of students and scheduling a common meeting time, if it is to make positive contributions to the quality of learning and staff development. Effective team teaching takes time to develop to its fullest potential.

Staff who are unfamiliar with it need time to work through the basic issues and routine matters before they can turn their attention fully to issues which affect students and to the impact which their teaching has on the department as a whole. This is time well spent because team teaching can be a valuable source of personal and professional development for those who engage in it. It can also be a source of considerable frustration if its goals are unrealistic, meetings are not productive and decision making is not well handled by team leaders.

## CONCLUSIONS

Adopting *instant* discussions in theory courses can not only improve students' efficiency in class and help them focus their minds on their studies, but can also enhance classroom interaction. The innovation and characteristics of inquiry teaching reform in numerical calculation courses as reported in this article lie in the introduction of new type team-based learning.

Based on random groupings, the authors in this article have reported on the new type team-based teaching reform in the classroom, adopting team-based after-class learning, and team-based learning to encourage students to become deeply involved in team activities. After more than three years of actual teaching practice, this work has achieved satisfying results.

New type team-based learning has several distinctive features:

1. Each grouping is conducted randomly or other team-grouping methods as shown in Figure 1.
2. Individual performance accounts for 50% of the total score, which is graded on team activities, and so students have to actively participate in team activities.
3. Each student in team activities acts as both host and overseer, which can exercise students' organisational abilities and a team's co-operative ability.
4. New type team-based learning has the effect of *principle of co-existence* and *barrel principle*, and it emphasises mutual co-operation and competition to improve learning efficiency, and to promote mutual learning and progress.

To sum up, a set of teaching schemes primarily targeting team-based learning was designed. This involved in-class theory teaching, homework, experimental teaching and other aspects. After a period of concrete implementation, these schemes were found to play a positive role in promoting students' learning initiative, deepening theoretical study, as well as team co-operation and competition.

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