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Discussion on Teaching of Linear Algebrain Local University

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***Abstract* – Linear Algebra is one of the most important and fundamental courses for students of engineering and science. In this paper, analyzed the status of Linear Algebra teaching of the higher teachers professional, and proposed to active learning strategiesin the Linear Algebra teaching, which can enhance students study motivation. Furthermore, these strategies are expected to improve the quality of Linear Algebra teaching.**

***Keywords* – Linear Algebra, Active Learning, Assessment.**

I. INTRODUCTION

Linear Algebra[1] is the branch of mathematicsconcerning vector spaces and linear mappings between such spaces.Linear algebra is central to both pure and applied mathematics, and is also a course that students generally feel uninteresting, abstract and difficult to study. Many works have consisted in analysis of students' difficulties, trying of teaching strategies and experimental teaching, offering local solutions[2-4].

In my university, Linear Algebra is a compulsory course for most 2nd yearstudents inone semester with about 32-48 lecture hours, usually twice or thrice a week.Most of the lecturers still use a 'spoon-feeding' approach. Theteacher plays a leading role and transfers information. 'He or she is regarded as the authoritative expert, the main source ofknowledge, and the focal point of all activity. The student is the passive recipient of the information already acquired by theteacher. The teacher selects from the discipline the information to be taught, studied, and learned. Teachers deliver formallectures to transmit knowledge, and students attend lectures, take notes, read textbooks. After classes, students should complete homework every week and can be given feedback on this. If students have questions, they can meet teachers in teachers' officesfor help.At the end of each semester, allthe students are expected to attend closed-book examinations, which account for 80% of the final mark respectively, the other 20% coming from recordsof exercises (include homework).The total mark is 100, if a student's final mark is less than 60, he fails the Linear Algebra course.But actual assessment practices often have a harmful effect. Teachersuse examination as their main assessment practices and then lack sufficientinformation about their students. Marking and grading are overemphasized whilegiving useful advice is underemphasized. Feedback is eclipsed by marks or grades.Comparing students competitively causes low-achieving students to believe thatthey cannot learn. Therefore their desire to learn is damaged. Examination is soimportant that students learn to pass the examination rather than to learn. Some students complain that Linear Algebra is difficult, dull, and they don'tknow how to use it, or even whether it is useful.In recent years, with the growing amount of university enrollment, the quality of students showed a downward trend.Most students find it is hard to learn Linear Algebra.A considerable number of students do not gain a deep understanding of key concepts and theories and some of them forget what they have learned soon after the final examination.Taking the more suitable measures and improving the quality of teaching for the status of the students learning Linear Algebra, it has become an urgent need solving the problem in the teaching strategies.

II. IMPROVEMENTS METHOD

Keeping students interested in the courses is paramount. Without interest students incline to surface level learning. With interestthey are maybe likely to engage in deep level learning. Interesting applications are very helpful for motivating thestudents, and motivation is one of the most importantfactors of effective learning. Linear algebra is widely usedin many areas of engineering, computer science,communication science, and some other branches ofmathematics as well, so there are abundant examples fromwhich to choose. The only problem here is how to choose.Remember, the focus of the course is linear algebra itselfnot its applications. The students will have enough chancesto apply this powerful tool later.

In my university, some teachers try to teach everything in theclass. (We know this is due to their strong tendency to relyon the theory ofbehaviorists.) Students need only followtheir teachers. There is little space for them to think. In thiscase, the teaching is teacher-centred, and the students arepassive accepters.In my opinion, there's a chance to use some contemporaryapproaches to teachinghere.

A collaborative learning group is a successful way to learn different material for different classes[5]. It is where you assign students in groups of 4-6 people and they are given an assignment or task to work on together. This assignment could be either to answer a question to present to the entire class or a project. Make sure that the students in the group choose a leader and a note-taker to keep them on track with the process. This is a good example of active learning because it causes the students to review the work that is being required at an earlier time to participate.

For example, in matrix multiplication, students can be quite easilyconfused because the multiplication of matrices is notgenerally commutative, i.e. $AB \neq BA$. So two specialmatrices

$$A = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix},$$

can be used.

1. Ask students to calculate AB and BA.It is easy to obtain that

$$AB = \begin{bmatrix} 2 & 2 \\ -2 & -2 \end{bmatrix} BA = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

then AB≠BA.

2. Because

$$BA = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

and neither B nor A is a zero matrix, we can get anotherconclusion: If 2 matrices A and B such that AB=0, itdoes not mean A=0 or B=0

3. Let students discuss their thinking about this question insmall groups: If three nonzero matrices A, B, C suchthat AB=CB, could you deduce the result A=C?

For example,

$$C = \begin{bmatrix} 2 & 0 \\ 0 & -2 \end{bmatrix}$$

Thenask a representative to share the thinking with the class.One interesting thing in all the groupand class discussions that took place is that we haveaccess to what the students say or think, and that is why it is so impressive to follow theirconversations. In our course students were encouraged to express freely what theythought and this contributed to their willingness to share their incomplete attempts tosolve the problem. With face-to-face discussions, we can see the kind and level ofmathematical reasoning that they can employ, where they fail, and how they try toconvince each other.

Using computers, which are so powerful, it is possible to change the teaching and learning of Linear Algebra totally.Firstly, using animation techniques, linear algebra might be shown on the computer screen geometrically (of course in cases of 2-D or 3-D), so it is much more intuitive rather than abstract, and easier for students to understand. Secondly, my students are from engineering, computerscience or economics. So I'm going to do some linearalgebra experiments and demonstrate more applicationsusing MATLAB. This part is taken in one of the computer labs withemphasis on linear algebra as an experimental science; this emphasis will be found in computer projects, computer exercises, certain examples, and applications on computers.

III. Improve Assessment Method

As we know, assessment is a significant component of teaching andlearning. In the past, the final closed-book examination at the end of each semester contributed 80% to theassessment. Some students study very hard in the last few weeks for the examination. Some of students successfully pass the examination, but they forget most of the knowledge when they have completed the examination. This assessment does not evaluate students properly. Our principles of assessment will mainly be to stimulatestudents to work hard and produce deep level learning. Thefinal examination will not rely on memory but onunderstanding. We will introduce some theories of goodlearning and let students discuss the assessment problem.Every group should write a report and some representativeswill be asked to make a presentation of the report. Surfacelevel learning will not get a high mark. Students can choosea surface learning strategy if they just want to pass theexamination and do not like hard work.So we should modify the traditional assessment as following :

1. Oral presentations: Students participate in class discussions and present group conclusions. Students also present course projects. (10%)
2. Homework: These are pencil and paper exercises.(10%)
3. Reports: These are carefully written report documents that require a more detailedexposition of idea. Reports are comparable to scientific term papers. They approximatethe kind of activity that many students will be involved in through their professionallife. (10%)
4. Computer projects: These projects are prepared with mathematical package to which thestudents have access in a mathematics computer lab. These projects involve ideas thatextend the standard material, possibly some experimentation and some writtenexposition in the form of brief project papers. These are analogous to lab projects in thephysical sciences. (20%)
5. Final exam (two hours in class exam). (50%)

IV. Conclusion

Linear Algebra is a professional foundation course which has strongly theoretical and practical. If we want toachieve good teaching effect, it is necessary for us to implement teaching reform and improve teachingmethods.Allteaching and learning methodologies aim at improving thequality of education. Our plan is to change strategies andaim for a more student-centered approach to teaching andlearning. The purpose of the change is to improve theoutcomes of teaching and learning in the course

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