

The effective use of LaTeX drawing in linear algebra ---- Utilization of graphics drawn with KETpic

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We have been developing KETpic which is a macro package of computer algebra systems to draw fine (precise and beautiful) LaTeX figures. We displayed the KETpic versions for Maple and Mathematica in the previous CADGME conferences. Recently we have migrated it to Scilab. Since each of these versions enables us to use symbolic calculations for programming, the procedure to draw figures has been made much more natural for teachers, and the class materials containing those figures can be made easier to understand for students. Here, our main interest is in the use of geometry (or graphics) to teach and learn linear algebra. This topic has been systematically studied by Ghislaine Gueudet-Chartier. Her research illustrates that the use of graphics tends to be held off in case of general linear algebra compared to the case of low dimensional Euclidean spaces. As a reason of this gap, it is pointed out that the effect and the limitation of using geometry to teach and learn general linear algebra have not been precisely realized by many mathematics teachers. Based on our questionnaire survey in Japan, we have been analyzing what sort of graphics are needed by mathematics teachers in their teaching linear algebra, and the reason why many teachers hesitate to use graphics. This result seems to coincide with the result of our survey on linear algebra textbooks (in Japanese and English).

In this talk, we will propose the following points:

- (1) Persisting in the opinion that linear algebra is a general theory to unify various mathematical objects seems to reduce the teachers' incentive to use graphics. However, many objects which motivate students to learn basic concepts of general linear algebra (such as linear subspaces, basis, linear maps, matrix representations etc.) can be found also in the geometric (Euclidean) context. Hence, the use of three dimensional Euclidean geometry should have strongly positive effects on learning such objects.
- (2) Since the 3D-graphics drawn with KETpic are equipped with high accuracy (due to the use of CAS) and rich perspectives, those graphics should serve as a great help to students in their learning linear algebra. We will illustrate those effects based on our students' interviews.