Investigating the Mathematical Components of Engineering Expertise

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We will present the design, and discuss the mid-project findings, of a one-year project that is examining how mathematical ideas and techniques are used in the practice of engineering, based on case studies of professional engineers working on design projects in several large civil engineering consulting firms. We are especially concerned with the observation of mathematics as used in workplace activities, rather than merely asking people to describe what they think they do. This is because we want to look beyond those elements of work conventionally described as mathematical (such as techniques learnt in school or university) to try to observe situations in which a more general, and harder to specify, "mathematical literacy" is involved. These situations are made complex by the fact that engineering design is done by teams of people, made up of different kinds of specialists, where mathematical work may be the principle responsibility of only a small part of the team. We have a particular interest in the role of digital technologies in this collective design process: is mathematics becoming an ever more specialist realm, where non-specialists are increasingly the consumers of "pre-cooked" mathematics hidden behind the interfaces of software packages? We believe that this question is not as clear cut as it seems, if we admit a broader definition of mathematisation than the visible application of mathematical techniques.

The methodology and theoretical basis of this project are derived from a previous project carried out several years ago at the Institute of Education, which examined the mathematical practices involved in nursing, commercial aeroplane piloting, and investment banking (Hoyles, Noss & Pozzi 2001). We found that the various professional groups employed a variety of mathematical strategies which were finely tuned to their practice, yet simultaneously retained the notion of invariance that typifies abstract knowledge. We have begun to explain this phenomenon in terms of a theory of "situated abstraction" (Noss & Hoyles 1996), and the current project is developing this theory by carrying out research in a domain of practice where we can see sophisticated kinds of mathematics (geometry, algebra, calculus) that entail complex structures of abstractions in their practical application.

References

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