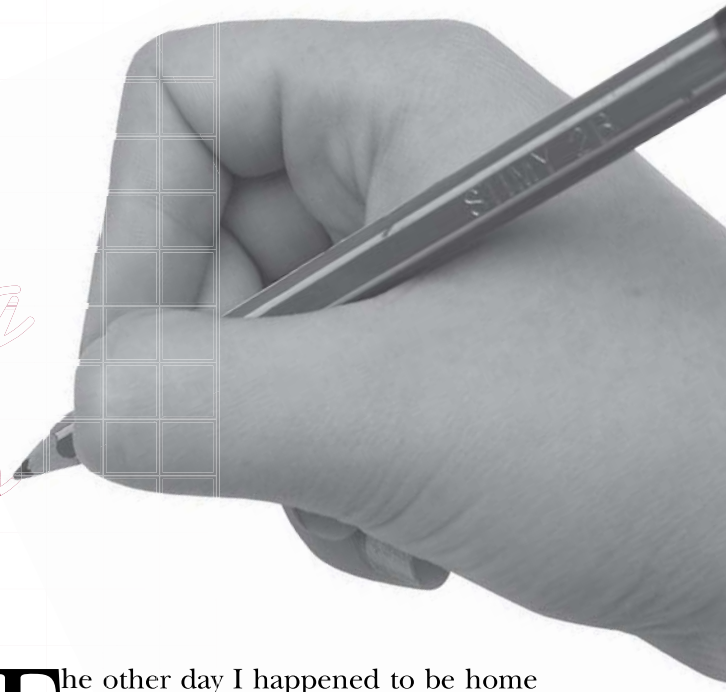
Homework and Learning Mathematics



PETER GROOTENBOER describes his children's experiences with homework and makes some recommendations for appropriate homework tasks.

The other day I happened to be home when my three children arrived home from school. After the usual greetings and discussions about their day, as a good parent I asked the obvious question: "Do you have any homework?" My post-primary son gave me a monotone "Maybe," and then after collecting what seemed to be about two full packets of biscuits, he got out his homework, his iPod, his portable gaming console, and his phone, and sat in front of the television. It seemed to me that he was doing some exercises from a textbook, listening to some music, playing a game, texting with his mates, and watching the TV all at the same time. Knowing about the capacity of millennials (Zevenbergen & Zevenbergen, 2007) to multi-task, I realised that all is well, or at least any interference on my behalf is not going to improve the situation, so he was engaging in the important task of doing his homework (until he got hungry and had to stop to get more biscuits).

My two girls are both in primary school, and they both also confirmed that they had some "maths homework." The one in her final year of primary school (Year 7) produced a page with 120 "expand and simplify"-type exercises and she was required to "finish them by Wednesday" (today was Tuesday). This was not as bad as initially thought because she had already completed 24 in class, meaning she had a mere 96 to go. Excitement and

enthusiasm were not high! As a supportive parent I tried not to sound too incredulous at her predicament, and instead said that, "It will help you pass the test" and "It shouldn't take too long once you get on a roll." I do not think she was convinced.

The youngest daughter (aged 8, Year 3) had a homework sheet for the week with spelling words and some addition exercises. She began the 10 sums and within two minutes she had completed them and was out on the trampoline having a lot of fun. About once every 60 seconds she would yell out to the other daughter and ask if she had finished and if she wanted to come and "jump on the tramp" with her. As she still had about 90 exercises to go, she moaned, "Not yet," and then did yet another "expand and simplify," and with each one her good humour, her enthusiasm for school and learning, and her attitude to mathematics dropped faster than the stock market during the financial crisis. At this point, I became specifically concerned about the impact of this homework on my older daughter, and more generally about the value of homework as an educational activity. The immediate concern was relatively easy to work on: I simply got her to complete a selection of the exercises to ensure that she had mastered the required skills, then I read out all the answers to the others and she wrote them in her book (bribed by a few lollies that I stashed away). However, reflecting on the bigger issue about the educational value of homework did not seem to have any such ready remedies. Indeed, I wondered more generally if it is homework, or is just schoolwork done at home? Anyway, what follows are some ideas and thoughts that I have noted as I have reflected upon, and read about mathematics homework.

Is mathematics homework necessary?

Putting aside the question as to whether this is in fact homework or just schoolwork done at home, the first fundamental question is whether homework is indeed useful and necessary in a students' education? The general consensus seems to be that all children should do homework because it is educationally valuable (Hyde, Else-Quest, Alibali, Knuth & Romberg, 2006). Almost every school has a homework policy and I think most parents expect and want their children to do homework, particularly in literacy and mathematics. However, although the belief in the essential nature of homework is pervasive, I found it difficult to find many research reports that supported this view, or sound reasoned arguments that theoretically ground the practice, at least in mathematics learning. After seeing my daughter struggle with her 120 exercises, I wondered if homework was not only not beneficial, but could actually be detrimental (I realise that not all teachers set their students such tasks for homework). Would she have been better off jumping on the trampoline with her sister or collecting little skinks in her bug catcher or riding her bike or… than sitting at the kitchen table completing mathematics homework? At the very least, I only want her to be doing these exercises and tasks for a limited time (indeed, most school homework policies have recommended time allocations for each level). Rightly or wrongly, she felt like she had "worked hard all day" and it was unfair that she had to do more work at home.

Mathematics homework should be "doable"

The one thing I can say about my younger daughter's mathematics homework is that it was within her mathematical capabilities. It was doable — in fact it was so easy that I do not think she even had to think about it! Of course, this means that there is a balance between setting homework tasks that students are able to do, but ones that are not trivial.

It is important that students engage in regular maintenance, and perhaps homework is a place for revision and reinforcement of previously-learned skills and techniques (but not 120 of them). That said, there is little

value in students practising mathematical techniques that they do not understand. The old adage is "practice makes perfect," but I think it is more accurate to say that practice makes permanent. I did a lot of practice on my golf swing before I was taught how to do it correctly and now my self-taught but faulty technique has become permanent—it is like a bad habit. If students practice mathematical techniques that are not eminently doable for them, then they may well find their own possibly incorrect solution, practice it, and it can become permanent. Also, if homework tasks are not readily within the competencies of the student, then it may well cause anxiety for the student and their parents.

Mathematical exploration as homework

Mathematics homework does not need to be just about practicing techniques and skills learnt in class that day. Indeed, homework can provide opportunities for students to explore mathematical ideas and concepts in their world beyond the classroom walls. For example, students could look at energy consumption in the home by collecting data on the appliances and other electrical aspects (e.g., lights) in their home. With their families, they could then look at ways of reducing their energy consumption and then measure the effects by taking regular readings from their meter-box.

It is a common misconception amongst students (and the population in general) that mathematics is useless, and the recent emphasis on numeracy has been developed to, amongst other things, address this concern (Zevenbergen, 2005). Homework tasks and activities that require students to use their mathematical knowledge and skills to solve real-life problems around the home can not only enhance their mathematical competence, but also their perceptions of mathematics as something that is, indeed, ubiquitous and useful (Leung & Wu, 2000).

Mathematics homework and parents

One of the most useful functions of homework can be to connect with parents about their children's mathematical learning (Kliman, 1999). It appears that teachers have done this well with reading for many years and so it would seem appropriate to try to connect similarly with learning in mathematics.

> When parents … regularly do mathematical activities with their children, and display a positive attitude toward mathematics, children benefit. They are more likely to feel confident in their abilities; to enjoy and learn more from the mathematics that they experience at school; and develop a sense of the richness, usefulness, and pervasiveness of mathematics (Kliman, 1999, p. 140).

Although many people would agree that it is a good thing to engage parents in their children's mathematical learning, the challenge is to find meaningful and manageable ways to achieve it. Three key factors in achieving this are finding appropriate tasks and activities, helping build parent confidence and engagement, and ensuring that parents and teachers have a shared agenda.

Homework tasks

Homework tasks need to welcome rather than alienate parents. It seems to me that there is no end of mathematical tasks and activities available in books, magazines and journals, and on the Internet, and some of these are good and useful. Indeed, every issue of APMC has many practical mathematical activities that can be used or modified to promote productive mathematical learning at home. Good homework tasks will have many of the qualities of rich mathematical activities in general, including:

- being accessible to the students at the start;
- having multiple solution pathways;

- requiring more than just the recall of knowledge; and
- having mathematical integrity.

Furthermore, as a homework activity it should invite parental involvement and engagement, and often apply mathematical concepts to real-life contexts.

Parental confidence and engagement

The disengagement of the general population with mathematics and the fear it evokes for many is well-known, and so it is common for parents to be anxious about mathematics. While most parents are happy and confident in helping their children with their reading, many appear less self-assured about their capacity to help with mathematics homework. It is critical therefore, that teachers and parents address this issue early in the school year. It would seem important that parents are encouraged to "have a go" at mathematical activities and be confident in their capacities to solve mathematical problems. This is not a simple task. One way this may be achieved is to have a mathematics evening (or series of events) for parents where they can come along and engage in some rich mathematical tasks. At these times, parents can also be given some tips and advice about how they can help their children with their mathematical learning at home, and of course these would be modelled in the pedagogy of the evening.

Shared agenda

Finally, it is important that parents and teachers are "on the same page" in relation to what they are trying to achieve with their children/students. Mathematics is a dynamic discipline and the world is an ever-changing place, and so it is not unexpected that mathematics and the contexts in which mathematics is used have changed since parents (and teachers) were at school themselves. In my experience, many parents see mathematics as a rigid and unchanging subject and so they expect that it is taught and learned the same way it was when they were at school, and the same way it was when their parents were at school. This can be an issue with homework, when, for example, students are asked to use a range of approaches to solve a problem but their parents, with the best of intentions, teach their children a standard algorithm. Again, this is an important issue that needs to be addressed through communication with parents, perhaps through a parent's mathematics evening as mentioned above.

Concluding comments

There is some evidence to suggest that quality homework can enhance the educational opportunities and outcomes for students, but it depends on the quality of the homework experience. We know that mathematical learning is a cognitive and an emotional activity (Else-Quest, Hyde & Hejmadi, 2008), and so teachers need to consider the academic integrity and the affective consequences when setting homework tasks. Homework needs to be accessible and engaging for students, but this does not necessarily mean simple or indeed, trivial. Furthermore, homework is an ideal place for students to explore mathematical ideas in their world outside the classroom. The value of mathematical homework can be enhanced if parents can be meaningfully engaged. Engaging parents will require some effort, but the rewards in terms of student outcomes are likely to make it well worth the effort.

Finally, if you are ever tempted to give students 120 exercises for homework, be assured that, at least for some students, they will learn that mathematics is irrelevant and boring, and most likely you will cause anxiety and tension in their home—this seems more like punishment for the students and the parents to me! Of course, if you are reading this, you are unlikely to do such a thing —

as a parent and mathematics educator, I thank you.

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